Exposure Assessment and Source Characterization of Lead in San Diego, California, Latino Children

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EXECUTIVE SUMMARY

Lead poisoning is a particularly insidious problem, causing subtle effects at very low levels of exposure; young children are typically most at risk. The current work was triggered by the concern that Latino children in California experience additional sources of lead exposure related to their cultural practices, in addition to the well-understood environmental sources that are highly associated with low socio-economic status. An assortment of environmental and cultural factors was evaluated, including housepaint, dust, soil, and water sampling and the administration of a questionnaire to determine family acculturation, socioeconomic status, access to medical care, prior child blood lead testing and child behaviors. Via the questionnaire, cultural exposures to potentially lead-contaminated Mexican products were also measured.

This 2006 cross-sectional exposure assessment study was conducted in 15 census tracts within the 92102 and 92113 zip codes south of downtown San Diego. It complied with San Diego State University Institutional Review Board procedures regarding the rights and protection of human research subjects. Parents or guardians of a total of 166 Latino children (aged 12 - 71 months) from 128 enrolled, eligible households documented their consent in writing to participate in the study. No eligible households were excluded from participating and the participation rate, at 68%, was quite respectable considering the often precarious legal and social status of this underserved group (77% spoke Spanish at home and 80% of parents/guardians identified as Mexican). Households refusing participation were found to be similar to those that participated, based on some simple statistics collected (Spanish spoken at home, exterior housing quality).

Blood lead measurements were accomplished on 89% of the children, none of whom were found to exceed the U.S. Centers for Disease Control blood lead action level of 10 µg/dL. The median value was 2 µg/dL, and nine percent had values of 5 µg/dL or higher, which triggered their enrollment in San Diego County follow-up programs to address their lead exposure. This prevalence is roughly double that reported for San Diego County children overall but in line with other national data on Latinos and especially work done by the Centers for Disease Control along the U.S./Mexico border.

Assessing sources of lead exposure was the principal focus of this study. No water samples were found to exceed the drinking water standard, but 12 exceeded the soil, another 12 exceeded the dust and 16 exceeded the paint chip standards (some houses had multiple exceedances). Referral of 29 residences (nearly one quarter of those participating) into the San Diego Housing Commission lead remediation program, funded by the U.S. Department of Housing and Urban Development, was accomplished on the basis of either blood lead levels of 5 µg/dL or above or environmental sampling results in excess of the applicable standards.

A significant part of the administered questionnaire focused on Mexican candy use, using photos to aid respondents' recall as to children's typical consumption. Estimates ranged from 1 to 6 g/day, increasing with child age. To estimate the lead exposure that such consumption potentially might entail, four years of data from the California Department of Public Health candy analyses under Assembly Bill 121 were examined. Mexican candies obtained in California by this program differed little or not at all from the overall group of total candies, with close to 90% of samples each year containing undetectable lead levels (< 0.05 µg/g). Integrated Exposure Uptake Biokinetic modeling indicated that these levels, combined with the child candy consumption estimates, are unlikely to be responsible for daily child intakes of more than 0.1 µg lead/day in the most extreme cases.

Reports of cultural exposures aside from Mexican candy use were surprising low. None of the study respondents stated that Mexican home remedies had been used although 11% of the children's respondents had some knowledge of these products (meaning they could identify photos by name and/or indicate where such products could be obtained). Only 11% of the children pertained to families that reported cooking or serving foods in clay pottery. The possibility of underreporting should be considered and addressed in future studies per the suggestions provided in the Discussion section of this report.

Multivariate regression analysis using the SAS statistical program's GEE model yielded a parsimonious model pointing to five primary factors driving blood lead levels: child age and gender, candy consumption estimates, soil lead levels and whether the child is covered by private health insurance. Although these results point to the possibility that both environmental and cultural components are driving Latino children's exposure to lead, this cannot be conclusively concluded without further study, since the candy consumption component did not involve direct lead measurements. The possibility exists that different levels of Mexican candy use simply represented the best measure of acculturation, ethnicity and/or socio-economic status.

This work has served an exploratory purpose, providing both a solid methodologic basis for future work and serving to generate hypotheses. The final section of this report includes recommendations for expanded future study of this issue, further promulgation of health-protective standards by the State of California and better use of the blood lead surveillance database (RASSCLE II), with the goal of lowering the blood levels of Latino, and all, children in California. Finally, the study's culturally-appropriate in-home phlebotomy approach proved so successful that its strategic implementation as a means to reach the most underserved Latino children merits consideration.

INTRODUCTION

The Latino population in San Diego County appears to be particularly vulnerable to the threat of lead exposure. Of the 859 lead poisoning cases reported to the County Health Department from 1992-2004, 84% occurred in Latino children (CEB, 2005a). In comparison, Latino children aged less than five years represented only 40% of the total population of children of that age in San Diego County (U.S. Census Bureau, 2000)[1]. Although Latino children are special targets of blood lead screening programs, and as such are over-represented with respect to their level in the population, this is not sufficient to completely explain their prevalence as lead poisoning cases (Courtney, 2005).

Data for 2003 indicates there were 306 reports of elevated blood lead levels (BLLs) in children under six years of age in San Diego County (CLPPB, 2005), compared with 219 in 2004 (CEB, 2005b). Half of the latter (2004 data) were reported to reside in the City of San Diego, with over two-thirds of those located within five key zip code areas in the San Diego downtown and San Ysidro areas. These are the data which informed this study at the time of its conception. More recent information is available on-line from the California Environmental Health Tracking Program (2010) and shows results for children aged 0 to 5 in San Diego County (Table 1).

Table 1. Prevalence of Elevated Blood Lead Levels in Children in San Diego County

Year	**2007**	**2008**	**2009**
Total screened (n)	35092	39885	46570
Prevalence (%) - Values $\geq$ 9.5 μg/dL	0.7	0.6	0.5
Prevalence (%) - Values of 4.5 - 9.5 μg/dL	4.7	3.9	3.8

The environmental component of lead exposure stems from housing constructed prior to 1978 when lead was banned as a paint ingredient, as well as soil contaminated by the historic use of leaded gasoline. Lower socio-economic (SES) groups tend to live in older housing in the city and in close proximity to the many freeways that crisscross the urban area of San Diego. They consequently can be expected to suffer higher exposures to lead-based paint and lead-contaminated soil, respectively. In addition, evidence is growing that cultural practices by Latinos increase exposure to lead, thereby elevating BLLs. Such practices include the use of lead-glazed pottery for food preparation and storage (Lynch et al., 2008), lead-contaminated Mexican candies (Courtney et al., 2002), and lead-containing products such as home remedies (Silva et al., 2005). Pica via ingestion of ground Mexican pottery has also been reported (Erdem et al., 2004). This study was designed to examine the importance of these various exposure sources among Latino children in the target area.

[1] Of the Latino population in San Diego County, 84% reported Mexican origin (U.S. Census Bureau, 2000), although the reporting category of “Other” could include additional persons of partial Mexican origin.

The primary goal of this study was to develop information on the extent of exposure to lead in a population for which such data is currently lacking. Evaluation of the importance of multiple exposures is necessary to strengthen both educational and physical interventions to prevent such exposures. This study was designed to produce the following information:

- Quantitative measures of lead exposure among the study participants, from the sources hypothesized to be most important:
  - Environmental, including paint, dust, soil, and water, and
  - Cultural, including pottery, candy, and home remedies.

- The correlation of socio-economic characteristics with lead exposure:
  1) Acculturation measures of the family and
  2) Access to medical care of the child.

This study combined environmental measurements with a face-to-face interviewer-administered questionnaire designed to elucidate the special exposure sources specific to the Latino population. The questionnaire was designed to quantify dose information for the use of Mexican products that have historically been contaminated with lead. It also identified additional risk factors by soliciting information on residence history and SES. Visits to the children's residences allowed sampling of housepaint, dust, soil, and water, as well as evaluation of Mexican pottery in use at the homes and collection of any home remedies known to contain lead (*e.g.*, Greta and Azarcón). In addition, observations on the household condition (paint condition inside and out, cleanliness of house, and degree of soil coverage in child's play area) were noted. Finally, global positioning (GPS) coordinates were taken for geospatial analysis. For non-responding households, both the GPS coordinates and exterior housing condition were noted.

METHODOLOGY

In 2003, a questionnaire was piloted in a downtown San Diego area with a high percent of households in which Spanish is spoken. The questionnaire was designed to elicit quantitative (dose) data on Latino children's exposure to lead. A dozen households were visited, and it appeared that the short, to-the-point questioning style was not generating adequate dose estimates. In addition, given that mothers likely receive conflicting messages regarding their use of Mexican products, it was unclear whether they were fully disclosing the extent of use. In October 2005, a focus group study was conducted to probe into mothers' perceptions of these products, with the goal of generating more effective and culturally-appropriate ways of surveying their use. The exposure questionnaire developed for the current work was based on the results of these two preceding studies (Dowling *et al.*, 2005).

The study protocol was submitted to the San Diego State University Institutional Review Board (IRB) for human subjects review and approved on Feb. 15, 2006. The study was piloted from February 18 to March 4, 2006, during weekday mornings and afternoons and weekend days, to test all study procedures, provide insight into the efficacy of the questionnaire, indicate rates of household response, identify missing households and point out any methodological glitches that needed attention. In the following week, minor improvements were made to the study instruments based on problems and suboptimal conditions identified during the pilot study. The modifications were submitted and final IRB approval was granted on March 20, 2006. The main part of the study, including recruitment and the in-home interviews and environmental sampling, was conducted from March 11 to June 29. In-home phlebotomy approaches were piloted during two Saturdays, March 11 and 18, 2006, and were so successful they were implemented for most Saturdays between April 1 and June 24, 2006. Toward the end of the study, due to the impossibility of reaching certain participants on Saturday, several weekday evenings were also included, primarily on Wednesdays and Thursdays from June 14 to 29, 2006. In addition, in a few particularly difficult cases (two mentally challenged children and children with very small fingers and/or poor blood circulation), the first blood draw was unsuccessful. In four such cases, the San Diego County Lead Coordinator, a Public Health Nurse, herself performed a second blood draw; these were during several weekdays throughout the study. The Lead Coordinator also drew blood from two children who were only available for first time blood lead test after the phlebotomy contract had expired.

ELIGIBILITY, RECRUITMENT AND ENROLLMENT

Within the target zip codes, census tracts were identified with at least two-thirds of households speaking Spanish at home. This is a key indicator of Latino origin, and was hypothesized to correlate to the lead exposures of interest. The following inclusion criteria were applied initially, during the pilot study:

- Households located in the study area of zip codes 92102 and 92113, and within census tracts 35.01, 35.02, 36.01, 36.02, 36.03, 39.01, 39.02, 40, 41, 45.01, 45.02, 47, 48, 49, and 50.
- Households containing at least one Latino child between the ages of one and five (12 to 71 months).

As a result of knowledge gained during the pilot, census tracts 41, 45.1, and 45.2 were removed from the study. During the pilot it was observed that these census tracts had experienced rapid gentrification, with demographic changes apparent in the six years since the 2000 US census. Of the 25 visited addresses in these three census tracts, only one contained any eligible participants. The decision was made that this was an unacceptably low hit rate, and these census tracts no longer contained a sufficient number of Spanish-speaking Latinos.

Eligibility was assessed during the recruitment process by administering the eligibility script (Appendix, Form A) to a responsible adult who lived in the home. In the absence of a responsible adult, different tactics were employed to decipher if a house was vacant or contained eligible residents. Information was accepted from knowledgeable respondents such as neighbors, property managers, or adolescents living in the home. Recruitment consisted of clearly explaining the study's purpose and procedure to parents or legal guardians of eligible participants in their preferred language (Spanish or English), then requesting their participation. In cases of multiple families living in a household, as per Brogan *et al.* (1994), all Latino children were included in the study and listed by age and gender in the study questionnaire (Appendix, Form G). The children's mothers were the preferred respondents, as they are typically the most knowledgeable about their children's health and behavior. Knowledgeable fathers and guardians were accepted if the mother was unavailable; in some cases both parents answered the questionnaire together.

Exclusion from the study was expected to be an unusual occurrence based on a condition that would prevent the subject from participating in the interview, *i.e.*, a disability or illness causing hearing or speech deficits. Study recruiters were also instructed to report potential subjects suffering from a mental illness or under the influence of drugs or alcohol to the Principal Investigator for follow-up. Only one such case occurred: during an initial visit in which the respondent appeared to be intoxicated, study workers immediately left. The household subsequently was visited repeatedly with no success; after seven visits it was classified as eligibility could not be determined. No information was gathered on non-eligible individuals, other than to note on study tracking logs (Appendix, Form D) that the household contained no eligible participants.

Study personnel canvassed selected addresses in teams of two, identifying households containing eligible children. Recruitment occurred at each individual household. Upon first contact with a household selected for the study, a responsible adult was sought, the field workers introduced themselves as workers in a joint San Diego State University/State of California children's health study, and permission was requested to briefly explain the study and ask the two eligibility questions (Appendix, Form A). If the household was then determined to contain eligible participants, a parent or guardian of each was sought to begin the informed consent process.

Study workers looked through residence windows, noted for-rent or for-sale signs posted on the property, and/or spoke with knowledgeable neighbors to confirm vacancy, but there were instances in which workers could not gain access to the property to determine either eligibility or vacancy. In cases in which it was not apparent if the house was vacant, yet there was a for-rent or for-sale sign posted, the study worker would call the real estate agency for information. Households that were obviously unoccupied received no further follow-up. For occupied households with no one at home, brief information cards (Appendix, Form E) were left on the door to inform individuals of the purpose of the study and to provide them with a number to call to make an appointment. In order to provide equal opportunity for these households, a minimum of seven and a maximum of ten additional attempts were made to obtain participation, on different days and times of the day. At each retry, the information cards were left. If still no response was garnered from a household, it was treated as if the occupant declined participation before eligibility could be determined, and the environmental assessment form (Appendix, Form H) was used for exterior observations.

Recruitment failure was tracked using pre-established codes (Appendix, Form C). Reasons ranged from 1) inability to determine any information about the household to 2) unoccupied households to 3) consent withheld at various stages of recruitment to 4) non-eligibility. Individuals determined to have eligible children (as determined by the eligibility script) but who did not consent to participate were questioned as to their reasons. Such questioning was only done with their consent, per the refusal questionnaire (Appendix, Form B).

For individuals who consented to participate, approximately 20 minutes were allotted for informed consent, with the parents/guardians of participants given the option to read on their own or be read the consent form, as well as to ask any questions they might have. Participant written names and signatures were obtained on the study consent forms (Appendix, Form F) to document the informed consent process. The entire process took on average of 15 minutes or less per participant.

Individuals in non-eligible households or neighbors in households not selected for the study who learned of the study and requested to be included were told that due to limited funding, not all households could be tested. However, such individuals were given educational information on lead exposure, poisoning, and prevention (see Additional Attachments to the Appendices) and their contact information noted and provided to the community partner, Environmental Health Coalition (EHC), to obtain identical services to the participant households, through additional EHC programs.

HOUSEHOLD SELECTION

Due to funding limitations and the expense associated with the analysis of environmental lead samples, the study sample size was limited to 150 households. The sample size estimate was expanded to correct for the average expected rate of successful recruitment per household in the sample area (Kish, 1965). The sampling unit was residential addresses (*i.e.*, households) purchased from the direct mail address supplier, Genesys Sampling Systems. The sample encompassing the requested census tracts contained 16326 entries.

"Hit rates", R, were calculated based on the following formula, for both conservative and generous assumptions regarding the number of eligible, available, and willing participants per household:

$$R = ER * OR * RR$$

where ER = eligibility rate (fraction of households with eligible children),

OR = occupancy rate (fraction of occupied households), and

RR = response rate (fraction of eligible households that consent to participate).

An initial estimate of R was garnered through the pilot study conducted in April 2003 (Dowling, unpublished data). Two clusters, each consisting of two contiguous blocks randomly selected using stratified sampling (probability proportional to size), provided estimates of R. From a total of 67 households contacted, 11 yielded eligible children, one refusal was noted, and there were several cases of households refusing any contact (*i.e.*, residents obviously at home but not opening the door). Only 40% of the houses received up to three contacts; for the other 60%, there was time for only two, which undoubtedly decreased recruitment success. With more adequate follow-up, the value of R for this pilot study would likely have been closer to one in five than one in six.

To assure that adequate numbers would be available in case the chosen hit rates ended up being unrealistic, a simple random sample (without replacement) of ten percent (1633 addresses) from this list was pulled. This was expected to provide more than enough addresses to meet the targeted sample size, and as such was divided into various sub-sections (replicates) to be released as needed. The first six percent of the sample (98 addresses) was set aside for the pilot study; an additional 50 percent provided the bulk of the main sample. Throughout the study, values for ER, OR, and RR were calculated, to better pinpoint the actual R and thereby make a final decision on the number of replicates that were released. As a consequence, two additional replicates were released as the study neared its completion but the desired hit rate had not been achieved: one of 9 and one of 5 percent. To increase efficiency in the field and conserve resources, addresses were grouped into replicates by similar geographic location.

In addition, because the sampling unit was households, but households were selected from a list of mailing addresses, unlisted households were considered. These were those which did not have a separate mailing address (trailers behind houses are common in this neighborhood) or which were erroneously not included on the Genesys direct mail list. To provide each household with a chance of being included in the study, a half-open interval approach was used. Study workers were instructed to include every unlisted unit up to, but not including, the next on the list.

Community Notification

Assistance in notifying the community of the study was provided by the Environmental Health Coalition (EHC). Outreach involved the methods normally used by this CBO, such as radio announcements, posters and flyers, public meetings, as well as school and community announcements. This prior notification was important to build support for the study teams' presence in the community, which contributed to their ease of movement and safety in the area. It also served to increase study participation rates. After the study was complete, a report back was presented in a community meeting format, with simple summary materials prepared for distribution.

Personnel and Training

SDSU master's students performed recruitment, interviewing and environmental sampling roles. Only public health students conducted environmental sampling. Workers were assigned roles in advance prior to the start of the study, according to their particular strengths, with some personnel were trained in both tasks. For example, although recruitment requires a certain degree of extroversion, it must not be conducted in a heavy-handed fashion. And interviewing requires sensitivity to the nuances of responses, as well as accurate recording capabilities. Teams of two people consisted of one recruiter/interviewer and one sampler, who worked together at each household. Bilingual capabilities (Spanish and English) were required for recruiting/interviewing personnel. Familiarity with both languages was required for sampling personnel. In all, the study had two interviewers, two environmental samplers, and one person who doubled as an interviewer and a sampler.

Personnel were trained to properly 1) screen/recruit participants and obtain informed consent, 2) administer the study questionnaire, 3) perform environmental sampling, 4) provide simple education on lead poisoning prevention, 5) properly complete all study paperwork and 6) function safely in the field. Study personnel received training in Lead Poisoning Prevention given by the Principal Investigator. This allowed them to answer basic questions regarding lead exposure and poisoning and to understand and explain the information presented in the educational materials distributed.

The importance of privacy issues were emphasized for all study personnel, including a short review of the applicable international treaties and federal law. Workers were sensitized to the importance of rigid adherence to the study protocol, and the need to immediately notify the Principal Investigator of any deviations. Another important theme of the general training was that of team safety in the field. All individuals were instructed to work in teams of two. Work was completed each day before dark. All workers were directed to leave an area at once if they should feel uncomfortable for any reason. Finally, they were equipped with cell phones at all times to call for assistance in case of emergency as well as with pepper spray to ward off attack dogs.

Additional training was given for each of the job types performed. Recruiters, who were generally the interviewers, were trained to identify households with eligible children and to thoroughly explain the study and request informed consent. Interviewers were especially trained to properly administer an epidemiologic questionnaire. Techniques on how to avoid leading questions, how to avoid prompting answers and how to properly fill out open-ended questions were emphasized. Samplers were responsible for spotting households that were not included on the original list. Their training emphasized standard methodologies for the collection of soil, dust and water samples. In addition, samplers received training on standardized observation techniques for housing stock condition. Samplers filled out observational forms while the interviewer administered the questionnaire.

DATA COLLECTION

All interaction with study participants, including the consent procedure, took place in the participant's preferred language (Spanish or English). Recruiters/interviewers for the study were either fully bilingual (two workers) or functional in both languages with Spanish (one worker) as the mother tongue. Samplers, who had only minor contact with study participants, were, although not bilingual, functional in both languages. All teams of recruiters/interviewers and samplers consisted of at least one fully bilingual individual.

Global Positioning System (GPS) technology was used to obtain the coordinates of the household. A hand-held GPS unit was used at the front door of the household. When the front door was located inside a building (such as for multi-unit apartments) where a satellite fix could not be obtained, the measurement was performed at the main entrance to the structure. When the entrance to the structure was impeded, such as with a gate, the measurement was performed at the point of the obstruction. For non-responding households, GPS coordinates were taken from the public sidewalk directly in line with the front door of the house using Garmin eTrex hand-help GPS receivers.

The administration of the exposure questionnaire, environmental sampling, visual observations of housing condition and explanation of the educational materials comprised the bulk of the contact with study participants. The entire process took a minimum of 60 and a maximum of 120 minutes. The average time was 80 minutes, but households with multiple children typically added 15 to 20 minutes per child.

The questionnaire (Appendix, Form G) of approximately 30-40 minutes in length was administered to study participant parents/guardians. The respondent was, in most cases, the parent or guardian who signed the consent form or, alternatively, another parent, guardian or primary care giver in the household. The questionnaire covered the following key points that were hypothesized to be important exposure sources or co-variates:

- Degree of acculturation of parents and children—including origin, citizenship, residency, and language(s) spoken
- Socioeconomic status—including educational level of parents and access to health care
- Prior blood lead testing of children
- Children’s activities—mouthing and pica behaviors, time spent outdoors and in places away from home
- Cultural exposure factors for the child—use of glazed pottery and home remedies, consumption of Mexican candies

All of the respondents were shown photos of nine categories of Mexican candies and asked to identify the candies that the child consumes. They were also shown a photo of Mexican pottery in use at the homes and another of a collection of home remedies known to contain lead (*e.g., Greta* and *Azarcón*). These photos appear in the Annex to this report.

Several observational measurements were made to obtain information on lead exposure sources, using the CDC’s simple observation sheet on the physical condition of the residence, including the degree of paint peeling (see Appendix, Form H). Additional elements were added to rank the cleanliness of the household and the degree of soil contact in the child’s play area. Parts of the survey that applied to the exterior of the house visible from the street were performed for non-respondents as well as survey participants. This information allowed the subsequent comparison of the responding and non-responding households.

The Principal Investigator reviewed all consent forms for completeness. Once completed, the consent forms were stored in a locked filing cabinet, to be retained for a minimum of three years according to the study protocol. They were destroyed in December 2010.

Sample Collection

House-to-house canvassing allowed sampling of house paint, dust, soil, and water. These included 1) a soil sample taken outdoors in the area that the child most commonly played; 2) a dust sample from the windowsill closest to where the child slept or, in the absence of a windowsill, from the floor near the child’s sleeping area; 3) a dust sample from the main entryway of the house and 4) a water sample from the kitchen tap. Proper chain-of-custody procedures were followed for all samples throughout the collection and analysis phases (see Appendix, Form J).

Environmental Sampling

Water samples were collected from the kitchen water tap into 50-mL polypropylene torpedo tubes to which 1% by volume trace-metal grade nitric acid (Fisher Scientific) had previously been added as a preservative. Soil samples were collected by scooping the top half-inch directly into polypropylene test tubes. Peeling paint chips were removed using polypropylene spatulas and transferred into resealable plastic bags.

Dust wipe samples were taken per the U.S. EPA methodology, Lead Sampling Technician Training Course 747-B-00-002, using a custom-made PTFE template measuring one square foot (1” x 1”) that was affixed to the floor with masking tape. Alternately, window frame samples were marked out with masking tape and the area within was wiped. The dimensions of the area were measured and noted after taking the dust wipe sample so as to avoid disturbing the area. Both types of dust samples were collected on pre-moistened "Ghost Wipes" (two wipes per area) obtained from Environmental Express. The two ghost wipes that were combined into a single polypropylene test tube at room temperature.

D-Wipe® towels from ESCA Tech were used to clean sampling implements between samples. Samplers used latex gloves when collecting all samples and changed gloves in between samples. All samples were coded using pre-prepared stickers with unique anonymous child-specific codes; samples that applied to more than one child were coded with multiple stickers. Samples were stored in their respective collection tubes or bags at room temperature while awaiting analysis.

Blood Samples

Parents/guardians were given the option, which they were free to decline, of blood lead testing at no cost for participant children. This group of children is high-risk for lead poisoning, and as such, national medical guidelines direct that they receive blood lead tests at ages 1 and 2, and any time from 3 - 6 years if no prior testing has occurred. To provide the participants with blood lead testing the research team paired with the local Community Health Clinic, which was familiar with the study population and employed bicultural/bilingual phlebotomists. These phlebotomists were trained specifically in the collection of fingerstick samples from small children.

If study participants consented to blood testing, lead study research assistants scheduled appointments by phone one to two days before the phlebotomist went out into the field and/or also made same-day appointments for the phlebotomist while she was working. The process, including the necessary paperwork, typically took 10-15 minutes per child. Finally, the phlebotomist visited in person the homes of participants who could not be reached by telephone. After using safety lancets to prick the children's fingers, Sarstedt Microvette® 100/200 blood collection devices with the preservative EDTA were used to collect the blood. Samples were stored in the field on ice in a thermos and transported to the analysis laboratory at the end of each work shift for refrigeration prior to analysis.

Laboratory Analysis

Environmental Samples

All samples were to be analyzed at the San Diego State University Graduate School of Public Health Laboratory using its Agilent Inductively-Coupled Plasma Mass Spectrometer (ICP-MS), model 7500ce. The technique of ICP-MS offers an extremely low detection limit (less than 0.1 µg/L in the final liquid digestate). Unfortunately, the ICP-MS broke down mid-way through the analyses and due to financial shortfalls, no money had been budgeted for repairs. Consequently, all of the water and dust samples, but only a portion of the soil and dust wipe samples, were analyzed at SDSU. The remaining soil and dust samples were analyzed at an accredited environmental laboratory, HM Pitt Labs, Inc. (San Diego), using Flame Atomic Absorption Spectrometry with a Varian SpectrAA 800.

No preparation was needed for the measurement of dissolved lead in acidified water, which was directly analyzed. The soil samples were oven-dried at 60°C for 24 hours. All dried soil, dust wipe and paint samples were digested using either U.S. EPA Method 3050B or 3051A. The detailed procedures that follow apply to the SDSU analysis; HM Pitt followed its own standard operating procedures.

Sample Preparation

U.S. EPA Method 3051A

Eleven soil samples (approximately 0.5 gram), nine paint samples (roughly 0.1 gram) and 31 entire dust wipe samples were digested in 10 ml of concentrated nitric acid within PTFE digestion bombs (Parr Instrument Company) heated in a laboratory microwave unit. The digestate was diluted to 50 ml with deionized water and allowed to settle. Prior to analysis, a further dilution was made when necessary, between 1/10 and 1/100 (soil and dust) or 1/1500 (paint), to obtain a lead concentration within the analytical standard curve.

U.S. EPA Method 3050B

The method used for the digestion of the majority (n=259) of dust samples was based on EPA method 3050B. Dust samples were dissolved in 10 ml of concentrated trace-metal grade nitric acid, digested in glass test tubes in an electric heating block at 95°C for two hours, and allowed to cool. An additional 5 ml of nitric acid was added, and the samples were heated for another two hours and again allowed to cool. A final 5 ml of nitric acid was added, and the samples were heated for another two hours.

Quality Control

For ICP-MS analysis, six calibration standards (concentrations of 0.1, 0.5, 2, 10, 25, and 100 µg Pb/L) were prepared via serial dilution of a 1 mg/mL Lead Atomic Absorption Standard obtained from Acros Organics. An internal standard of 1 µg/mL bismuth was prepared by diluting a 1,000 µg/mL Bismuth Atomic Absorption standard obtained from Fisher Scientific. All standard and sample counts obtained by ICP-MS analysis were corrected for their corresponding internal standard responses, and these ratios were calibrated against the standard curve to yield the resulting lead concentration.

Laboratory method blanks for each matrix were processed using identical preparation methods to the samples. Nitric acid alone was heated in PTFE digestion bombs for the soil and paint digestion method blanks. Nitric acid alone was heated in test tubes on the heater block for the dust digestion method blank. Blank "Ghost Wipes" were also digested in nitric acid and heated in test tubes on the heater block to measure background lead levels in the wipe material. The lead concentrations detected in each of the method blanks as analyzed by ICP-MS were as follows:

- Acid blank, microwave digestion method: 0.055 µg/L (n=5)
- Acid blank, heater block method: 0.018 µg/L (n=8)
- Blank wipe, heater block method: 0.379 µg/wipe (n=5)
- Blank wipe in microwave digestion bomb: 0.317 µg/wipe (n=1)

Standard Reference Materials (SRMs) certified by the National Institute of Standards and Technology consisted of the following: SRM #1640 Trace Elements in Natural Water, SRM #2709 San Joaquin Soil and SRM #1579a Powdered Lead-Based Paint. NIST soil and paint SRMs were processed identically to samples and recoveries calculated based on the known reference concentrations. In addition, dust wipe spikes were prepared by adding approximately 0.5 grams of NIST soil to a blank "Ghost Wipe" prior to digestion; again recoveries were calculated based on the known concentrations. Lead recoveries from the SRMs as analyzed by ICP-MS were as follows:

- SRM #1640 (water): 95%, CV=10% (n=4)
- SRM #2709 (soil): 65%, CV=12% (n=10)
- SRM #1579a (paint): 76%, CV=24% (n=10)
- Blank dust wipe spiked with SRM #2709: 68%, CV=12% (n=3)

NIST paint and soil standards were prepared for commercial analysis by HM Pitt, Inc., consisting of five separately prepared containers labeled in the same manner as samples, thereby blinding the laboratory. Recoveries were as follows:

- SRM #2709 (soil): 76%, CV=16% (n=4)
- SRM #1579a (paint): 47%, CV=66% (n=5)

Of the five soil SRM samples were submitted to the lab, one was under the limit of detection. The four detected samples ranged between 12 and 17 mg Pb/kg, only several milligrams above the detection limit of 10 mg Pb/kg.

Although the HM Pitt detection limit for soil samples ranged from 7 to 50 mg Pb/kg, for the vast majority of samples it was 10 mg/kg. Paint sample detection limits ranged from 23 to 167 mg Pb/kg. In both cases, higher detection limits were due either to sample dilution (in the case of samples with high lead concentrations which required greater dilutions before introducing the sample to the instrument) or to a low mass of available sample.

Blood Samples

Lead levels in whole blood samples stored in Sarstedt tubes were determined by the San Diego County Public Health Laboratory using graphite furnace-atomic absorption spectrometry with a Perkin Elmer AA 600. The blood was diluted 1:10 with a matrix modifier (containing Triton X, ammonium phosphate and nitric acid). A volume (12 uL) of the sample was inserted into the graphite furnace via automatic sampler and the lead content measured with background correction. The atomic absorption signal of the lead in the sample was quantified against known standard concentrations. The detection limit was 1 µg/dL and results were reported to one significant figure. At the time of the study, the San Diego County Public Health Laboratory was certified by the Wisconsin State Laboratory of Hygiene as CMS proficient (testing five samples in three graded proficiency tests per year).

Data Analysis

Certain differences in interpretation occurred for several questions, even though all the interviewers received the same training. Via discussions with the interviewers, these discrepancies were rectified and data entry was modified as necessary to fit the agreed-upon criteria and specifications. Nevertheless, certain assumptions had to be made; the most important are listed here.

- Respondents who were the guardians of the child participant, if information on the child's parent(s) was unavailable, were considered the child's parents for the purposes of the family portion of the questionnaire. This included two participants' grandmothers who were identified as the guardians.

- Years of primary and secondary schooling were grouped into the following ranges: elementary school (1-5), secondary school (6-9), high school (10-12) or higher education (greater than 12 years).
- Several households contained more than one family. A family was defined as a set of parent(s) or guardian(s) and child(ren).
- Addresses that contained shacks or trailers located behind or beside the main front house were considered separate households even if they shared a common address. The only exception was one front house which specifically indicated that the rear trailer was an extension of that same household.
- There were no serious discrepancies in data collection between the two different versions of the questionnaire (for the pilot and main study), with one exception. The question pertaining to the number of hours the child spent outdoors was significantly modified after the pilot stage of the study. The question asking how many hours the child spent outdoors away from home was removed; those data from the pilot were disregarded.
- For data entry, differences between the initial and final versions of the study questionnaire were reconciled to fit the final version of the questionnaire.

Data was entered either into a Microsoft Excel® spreadsheet (participants) or an Epi Info 3.5.1 form (non-participants). These served to generate simple descriptive statistics for environmental sample results, dietary data (converted into dose estimates) and child BLLs. Statistical packages STATA v. 8 and SAS v. 9.2 were used for advanced statistical analyses of the relationship between blood lead levels and the various predictor variables.

GPS coordinates for participating households were plotted using a geographic information system (ArcGIS) to create a layer. This was overlain on U.S. Census 2000 Tiger layers for major roads. GIS maps were created using ArcGIS® 9.2 ArcView® software.

RESULTS

PARTICIPATION SUMMARY

The study consisted of a total of 955 randomly sampled addresses (see Figure 1 for more details) including 22 unlisted addresses (not present on the original Genesys list). In two cases the household tracking sheets were lost in the field so no information can be included on these addresses. The ten cases for which no information could be determined about the address were primarily due to a complete lack of access to the property (such as with gated communities). Study eligibility was defined quite inclusively as a knowledgeable respondent stating that Latino children between the ages of one and five lived at a given address. In some cases the respondent was not a resident or the resident was not the parent or guardian needed to continue with the interview. In this case continued attempts were made to locate that individual to obtain either study participation or an outright refusal and thus administer the refusal questionnaire. If all such attempts failed, the household was logged as eligible/declined to participate.

After the pilot study the three northern census tracts (41, 45.01, 45.02) were taken out of the study, yet the information on the household visits in this area was included in the total tally of visited households (Figure 1). These three census tracts that were removed included a total of 25 visited households in which two of the households were addresses not on the original list. Only one of the 25 was an eligible household that was successfully enrolled. Other than that, two refused participation before eligibility could be determined, 19 were ineligible, eligibility was undetermined for two and one was unoccupied.

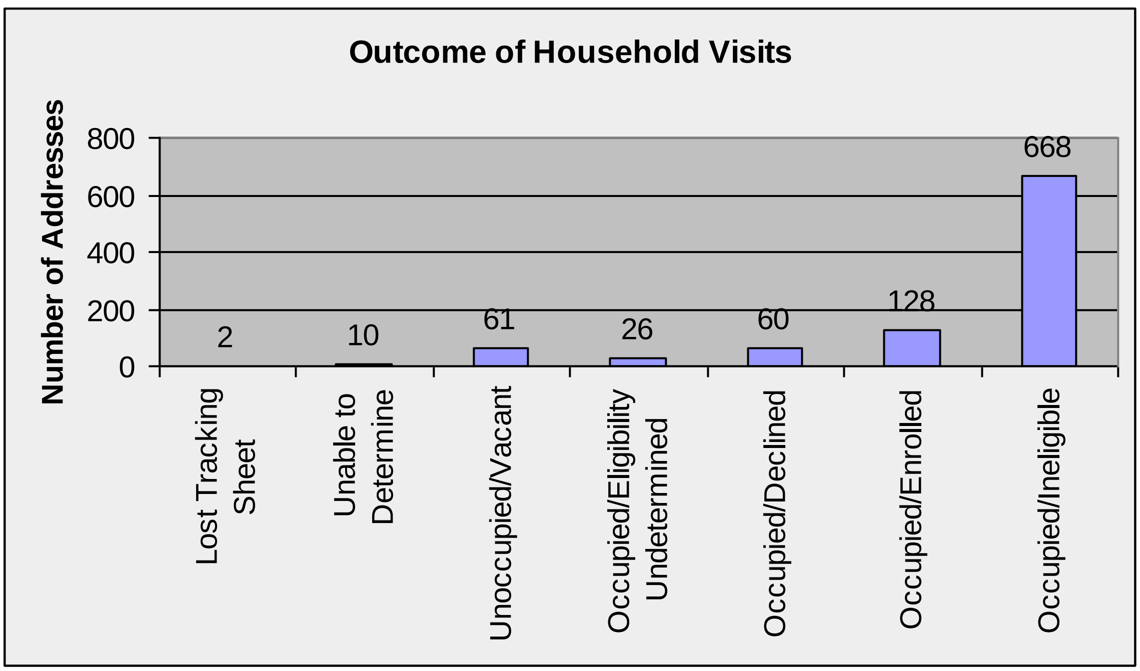

Figure 1

The totals for the entire study included 26 refusals from households before eligibility could be established. In addition, families in 60 households for which eligibility had been confirmed, subsequently declined to participate. Of these 60 households, two contained two families that both refused participation. Two additional households contained two families of which one participated and one refused; these households were classified as enrolled. The most common reason that individuals cited when refusing to participate was not having enough time. Others stated that 1) their child and/or home had been recently tested for lead and that there were no elevated levels of lead found, 2) they did not have the landlord's permission, 3) the house had been built within the last five years or 4) a move was scheduled within the next few weeks.

A rudimentary comparison of study participants and non-participants was possible based on the refusal questionnaire (Appendix, Form B). It was, however, common that some or all of the questions were not completed due limited or truncated verbal contact with eligible interviewees. Data which was successfully collected showed that somewhat more refusing respondents believed their children had had their BLLs checked within the last year (43% versus 40% for respondents) and 30% of the refusing respondents could state when that was performed. For the 61 families indicating the number of eligible children, there were 1.27 children per refusal family (this number was 1.26 for participating families). For the refusing households, 69, 8 and 23%, respectively, spoke only Spanish, only English or both Spanish and English. Those numbers can be compared to the participating households at 77, 7 and 16% (see Household section below).

There were no cases of eligible households being excluded from participation based on the study exclusion criteria. Enrolled, eligible households totaled 128, for a participation rate of 68% (calculated as the proportion of households enrolled in the study out of the total number of households identified as eligible).

Interview respondents were typically mothers (139 or 84%), followed by fathers (8%), aunts (2%), and finally legal guardians (1%). Eight interviews (5%) were conducted with both parents present. The vast majority of the questionnaires were conducted in Spanish (140 or 84%), with the rest in English.

DESCRIPTIVE STATISTICS

Household Level

There were a total of 166 participating children living in 132 families:

- 99 families had one eligible child,
- 32 families had two eligible children, and
- 1 family had three eligible children.

These 132 families were living in 128 households:

- 93 households had one eligible child.
- 32 households had two eligible children:
    - two of these households contained two families with a single child each and
    - the rest (30) were single families with two eligible children.
- 3 households had three eligible children:
    - one of these households contained a single family with three children and
    - two contained both a single-child family and a two-child family.

The number of occupying families in the households we studied (irrespective of eligible children) varied from one to three:

- 76 households contained 1 family,

- 43 households contained 2 families,
- 8 households contained 3 families, and
- 1 household had an undisclosed total number of families.

The mean number of occupants per household was 5.7, with a median of 5 (see Figure 2); this excludes a single household for which the number of occupants was undisclosed.

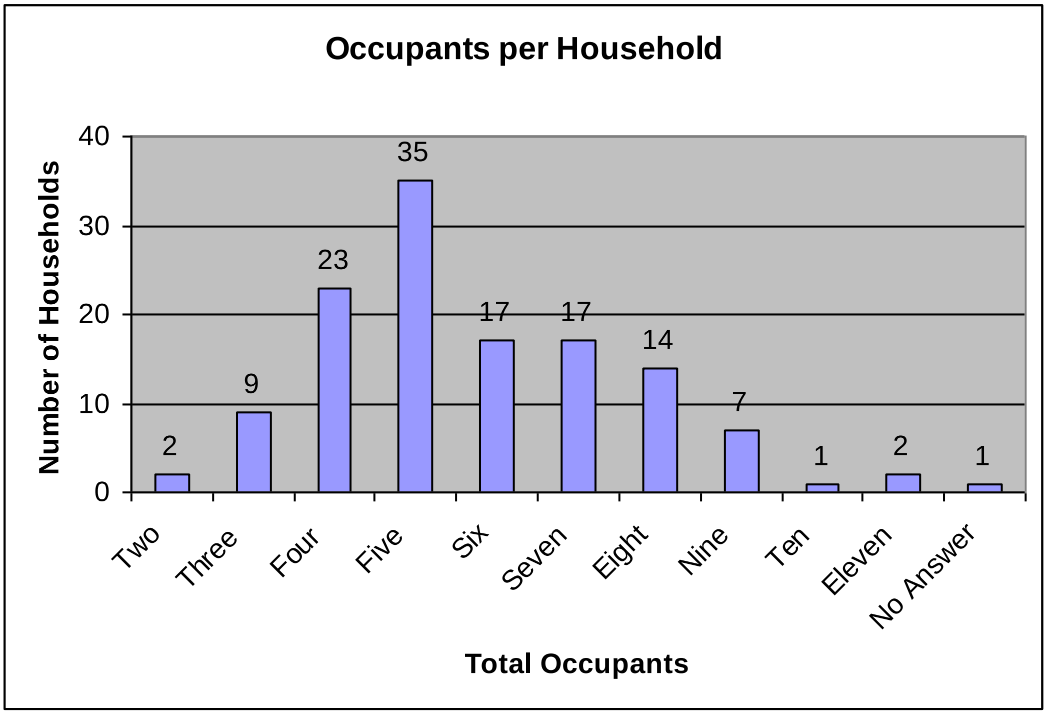

Figure 2

Only 31 residences (24%) were owner-occupied; 97 were rented. Although the options of public or publicly-subsidized housing were given, none of the respondents chose these responses. Excluding four respondents who were unsure, 41% reported some work had been done on the residence within the last six months:

- only interior work (n = 28),
- only exterior work (n = 5) and
- both interior and exterior work (n = 18).

Reports that a household resident participated in activities that are commonly implicated in lead exposure were given in 43 cases (for a single activity), 9 for two activities, and once each for three and five activities. In contrast, 72 respondent households stated that none of their residents participated in the specified activities, while two households did not provide any information. The most common activities were employment in the construction industry (39 reports) or as an automobile mechanic or welder, with 11 reports each.

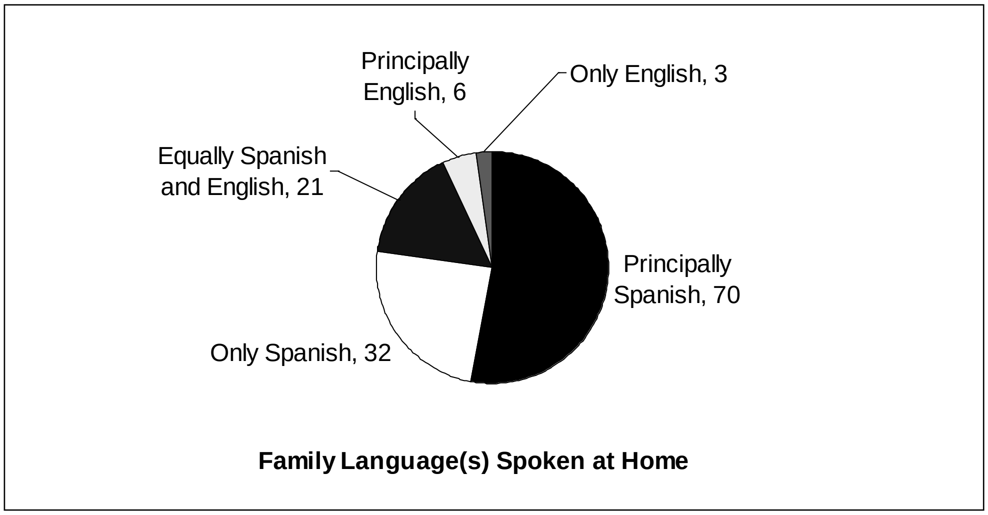

Figure 3

Family Level

In only two of the 132 families, the mother of the children did not reside in the home; in one case, the father resided in the home with his extended family including his sisters and mother and in the second, the father of the child participant was divorced, no longer lived with his wife and shared child custody.

Spanish was exclusively or principally the language spoken at home for 77% of the families (Figure 3). The majority of the participants' mothers either self-identified or were identified (in case the respondent was not the mother) as Mexican (83%) and all but one reported some other type of Latino identity (14%); see Figure 4.

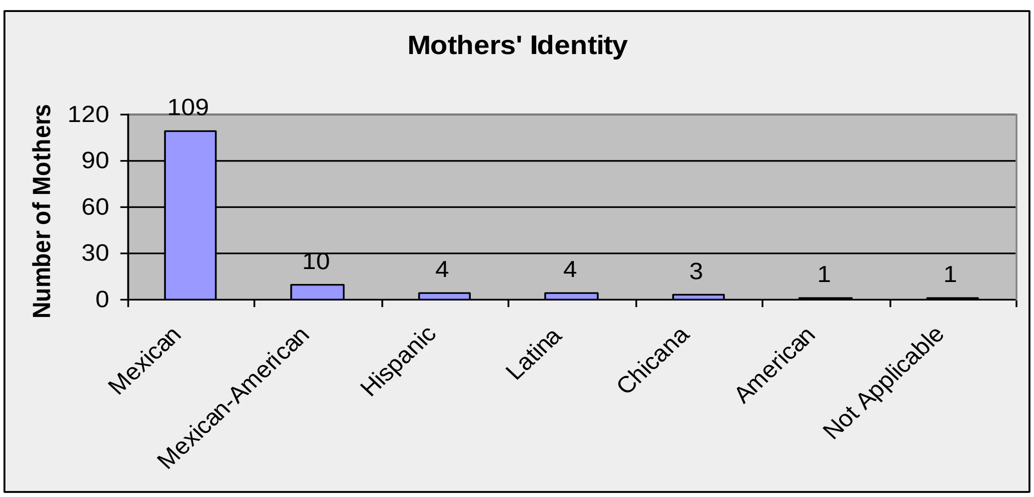

Figure 4

Similarly, the fathers were primarily identified or self-identified as Mexican (75%) with all but eight of the remaining fathers associated with a type of Latino identity (19%); see Figure 5.

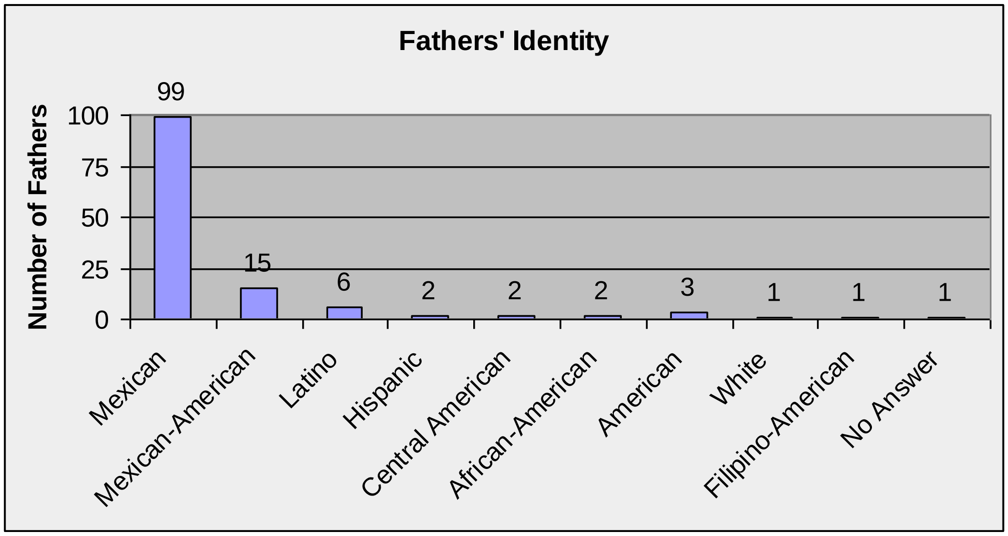

Figure 5

The majority of the mothers had attended high school (42%) or college (20%); details appear in Figure 6. The schooling primarily took place in Mexico (64%), but 23 percent of the mothers studied in the United States and 11 percent had studied in both places; information on mothers' schooling was missing in two cases because the respondents did not know the answer.

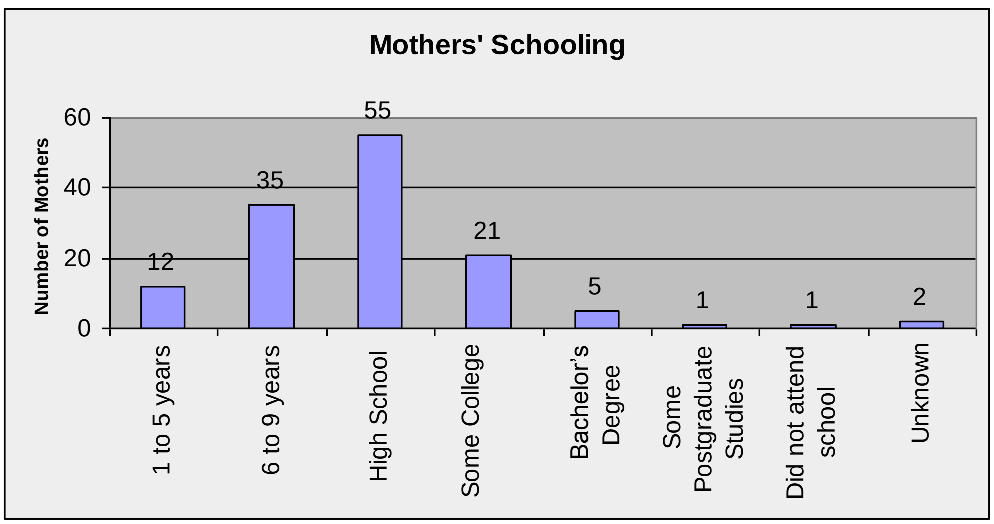

Figure 6

Fathers were slightly less educated than mothers when comparing higher education; 42 percent of them went to high school, while only 11 percent attended college; see Figure 7. The fathers' schooling primarily took place in Mexico (61%); a smaller percentage studied in the United States (23%), while 13% studied in both. Data on where schooling took place for three fathers was not obtained**.**

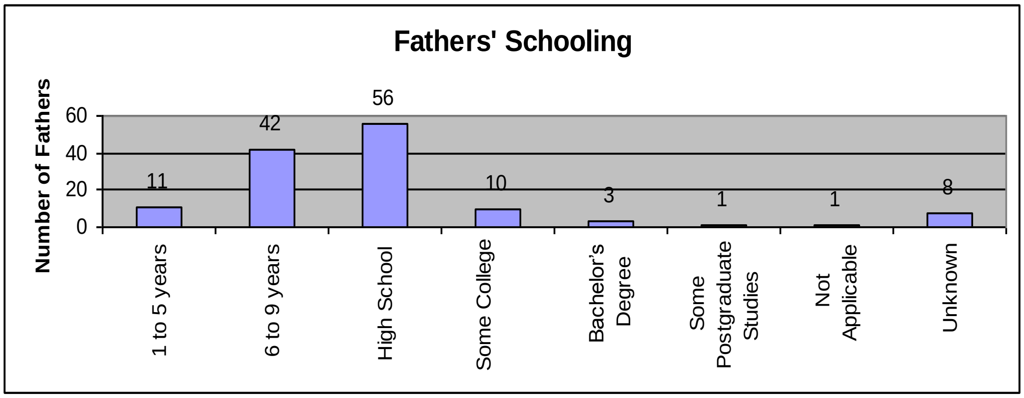

Figure 7

Of the mothers, 57 percent did not spend any time in Mexico within the last year, 23 percent spent less than one month, and the remainder spent between one month and one year (excluding two responses that were not obtained). Fathers spent slightly more time in Mexico: 47% had not spent any time in Mexico in the last year, 26% spent less than one month, and only 8% spent between one month and one year. However, 26 responses (20% overall) were not obtained because the father no longer lived in the residence; in two cases the respondent did not give an answer.

For a total of 29 families, the father of the children did not reside in the home. Out of those 29 families, 24 did not have another man living in the home in place of the father, four mothers stated that they had a male partner living with them, and one mother did not give an answer. Two of the mothers' partners were Mexican immigrants and had attended school in Mexico; the other two were not immigrants and attended school in the United States. The male partners represented a range of schooling with one in each category: elementary, secondary school, high school, and some college.

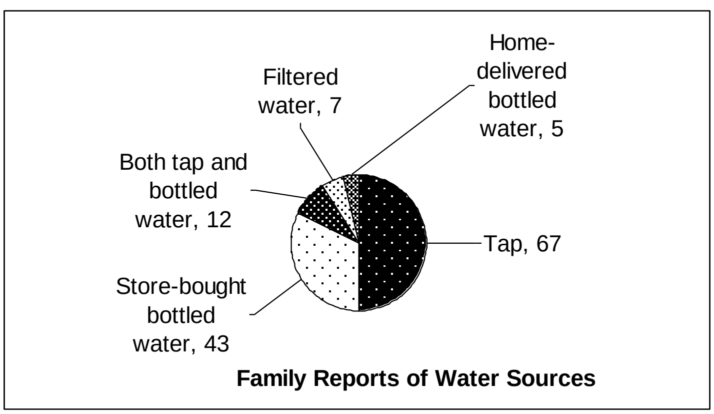

Figure 8

Family Food and Water Exposures

Two families reported multiple water sources giving a total of 134 responses. A significant amount of the water used for cooking came from the tap (50%), followed by 32 percent from bottled water purchased at a store (Figure 8).

Many of the families reported using more than one type of cookware (Figure 9). Teflon/non-stick was the major type of cookware, followed by aluminum. Interestingly, only four families reported using clay (*barro*) cookware.

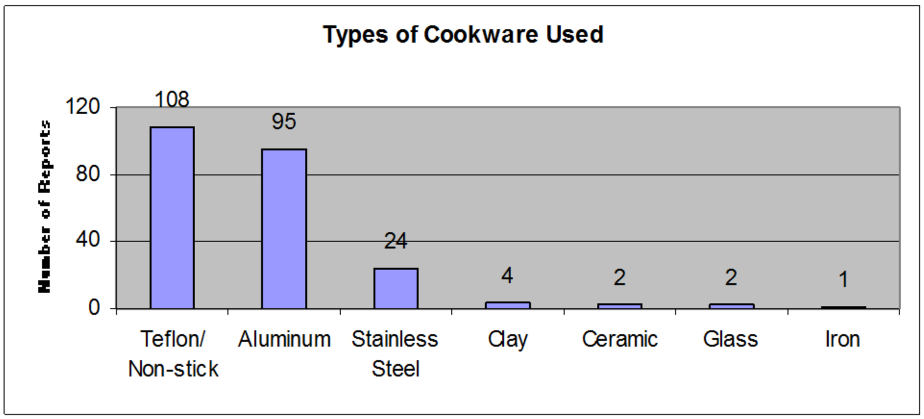

Figure 9

Although only four families reported using clay cookware, when asked what they usually cook in clay pots, 13 families identified different types of foods, with three families identifying two foods. Beans were the main food named (10 reports) followed by rice (3), with single reports of *atole*, soup and *mole*. Eight families also gave 14 reports (up to three per family) of foods that they usually serve (as opposed to cook) in clay pottery: two reports each of coffee, punch and chips, and one each of *atole* (hot cinnamon milk drink), soup, *pozole* (beef stew), *tortas* (sandwiches), salsa, *chile*, cilantro, onions and shrimp. Only three families reported both cooking and serving foods of any sort in clay pottery and only one of those reported cooking and serving the same food (*atole*).

Child Level

Most of the information in the questionnaire was specific to the child and his/her characteristics. The study had a slightly higher percentage of female participants (56%) with a total of 93 females and 73 males. Overall, the age of the children was nearly evenly distributed between one and five years (Figure 10).

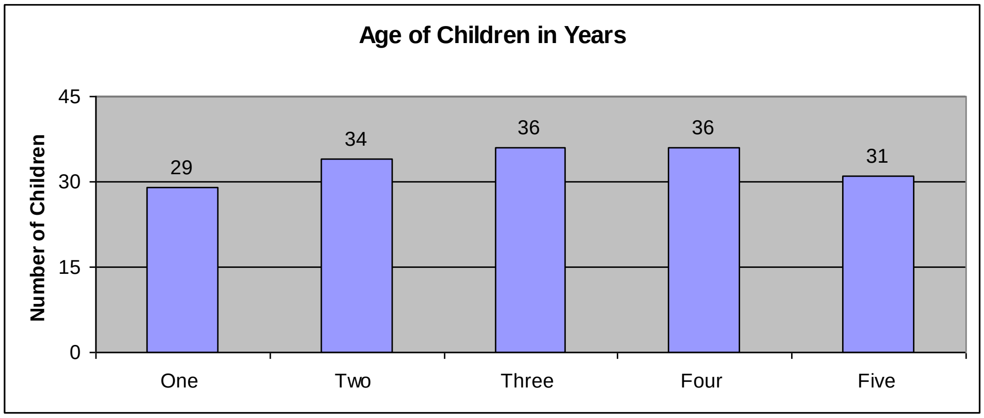

Figure 10

Both parents of the majority of the child participants were Mexican immigrants (76%). A small percentage (6%) of participants had no parents of Mexican nationality; see Figure 11. The citizenship of the study participants included 12 children with Mexican citizenship, 3 children with dual citizenship (all of whom were California-born) and the rest of the participants (91%) with solely United States citizenship. The children were overwhelming born in California (149), with one born in Texas, one in Arizona and three in U.S. non-border states. Only twelve children (8%) were born in Mexico (one in Baja California Norte and 11 in Mexican non-border states).

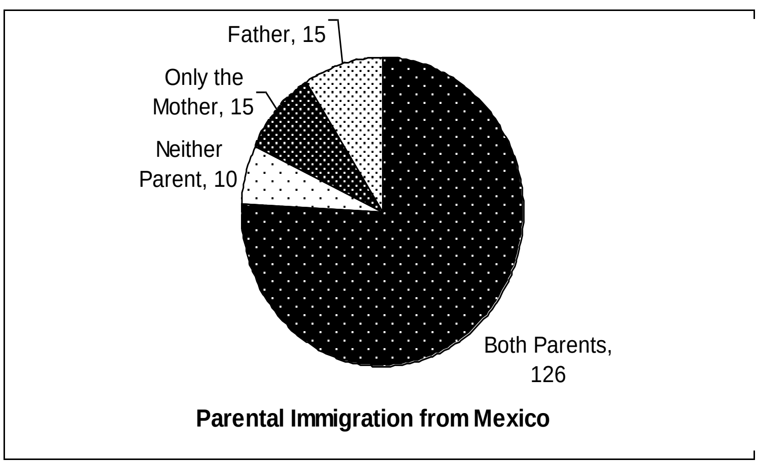

Figure 11

It was established that 17 children did not spend any time outdoors during the week. The majority of the children (76%) spent two hours or less outdoors on weekdays. Note that hours are reported as daily averages (Figure 12).

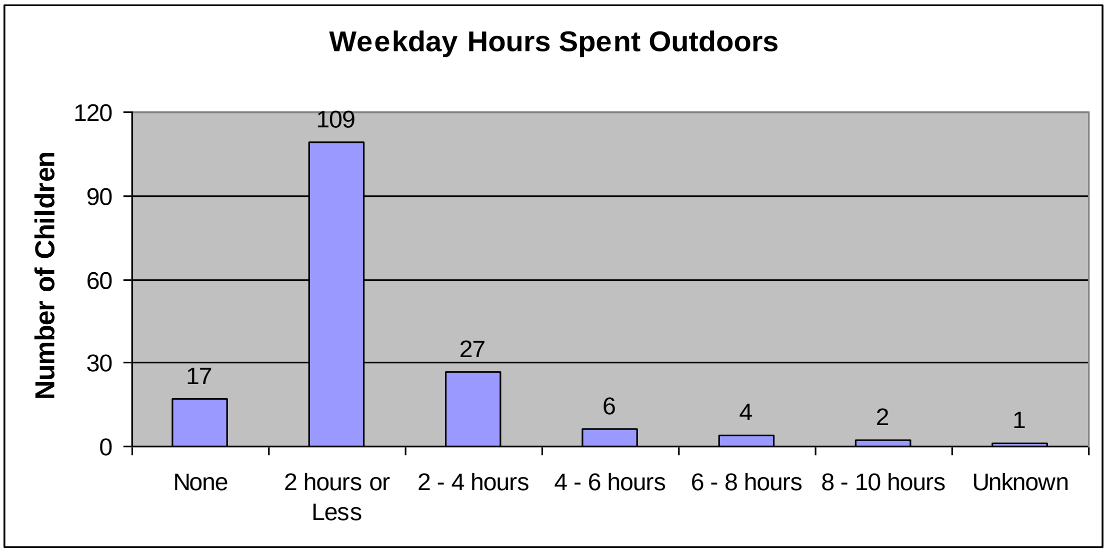

Figure 12

During weekends, 31 children did not spend any time outside, but those that did tended to spend slightly more time outdoors on weekend days than on weekdays (see Figure 13 where once again hours are reported as daily averages).

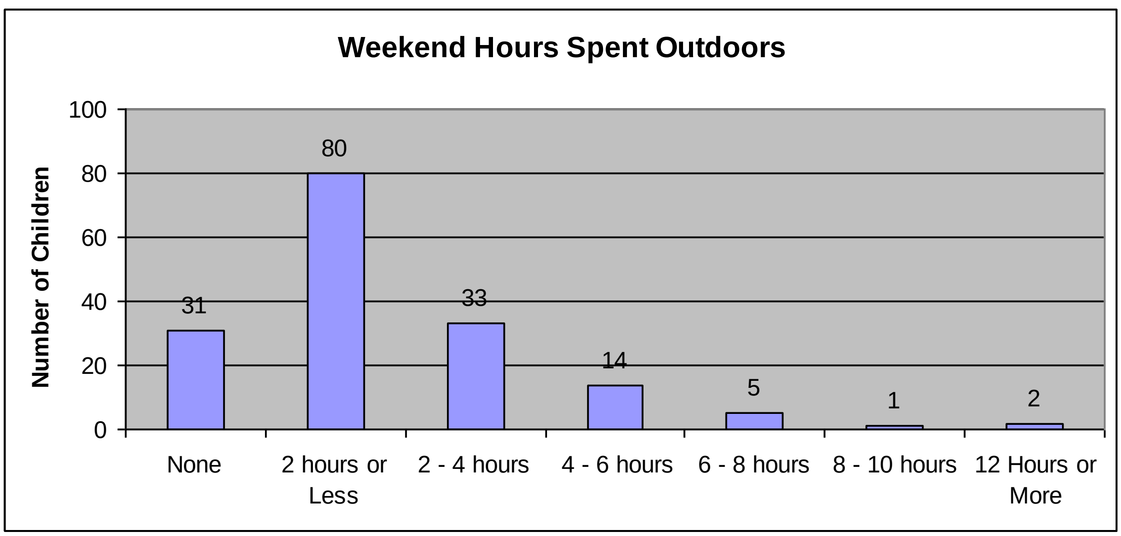

Figure 13

It was determined that 86 children spent 10 hours or more a week at a place other than their home, while 80 did not. The number of places those children spent time varied from one (in the case of 72 children or 43%), two (for 12 children) to three (only 2 children). Overall there were a total of 102 reports of places in which these 86 children spent more than 10 hours away from home. Figure 14 shows the five different places the children spent away from home.

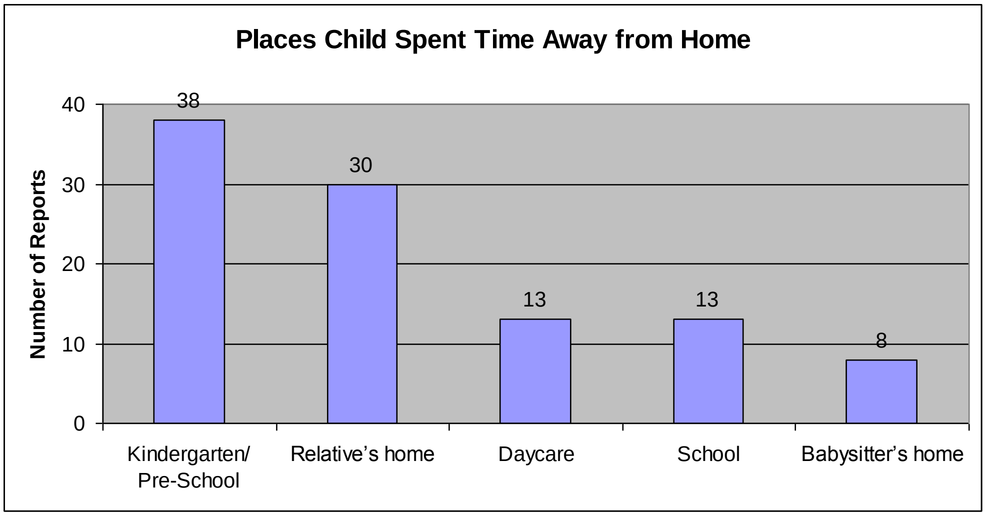

Figure 14

In general, almost all of the children spent more than 10 hours at another place other than home (Figure 15). Between 10 and 20 hours were spent at another place for 37 percent of the children, while 43 percent of the children spent between 20 and 39 hours at one place away from home.

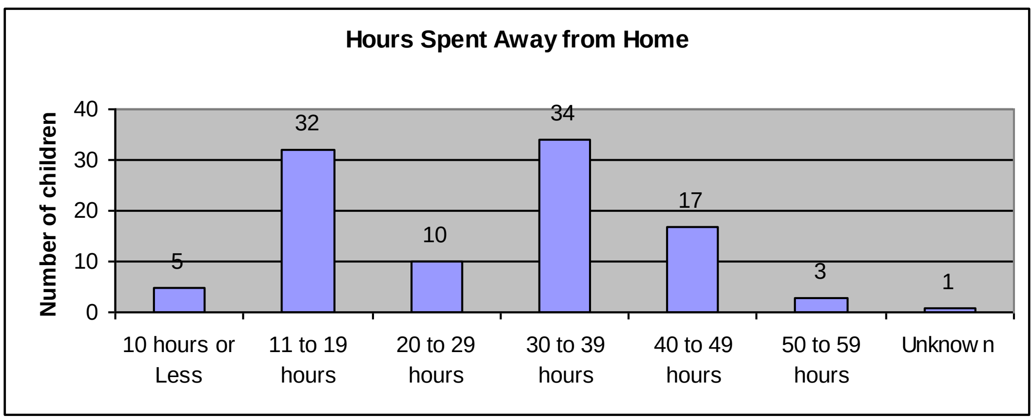

Figure 15

The study area, which included the zip codes 92113 and 92102, had been the home of 109 children for their entire lives and 108 had lived in the current residence visited for this study for their entire lives. Therefore, only one child in the entire study had changed houses within the study area during his/her life.

Less than half (76) of the child participants had gone to Mexico within the last year while 90 children had not. Many children who had visited Mexico within the last year had visited more than one Mexican city and/or state. Respondents reported a total of at least three different places in Mexico that the child had visited within the last year:

- One child visited up to three different places
- 15 children visited up to two different places
- 60 children visited only one place

In all, 93 different places were visited by the 76 children. Seventy of those visits were to a Mexican border state, while 23 were to a Mexican non-border state. In 45% of the visits, children spent less than a week in that place; in 38%, the period was one week up to less than one month; the remainder was for one month or longer.

Child Food, Water and Home Remedy Exposures

Nine children had multiple drinking water sources, for a total of 175 responses (Figure 16); 81% of the children's drinking water came from bottled water purchased from a store.

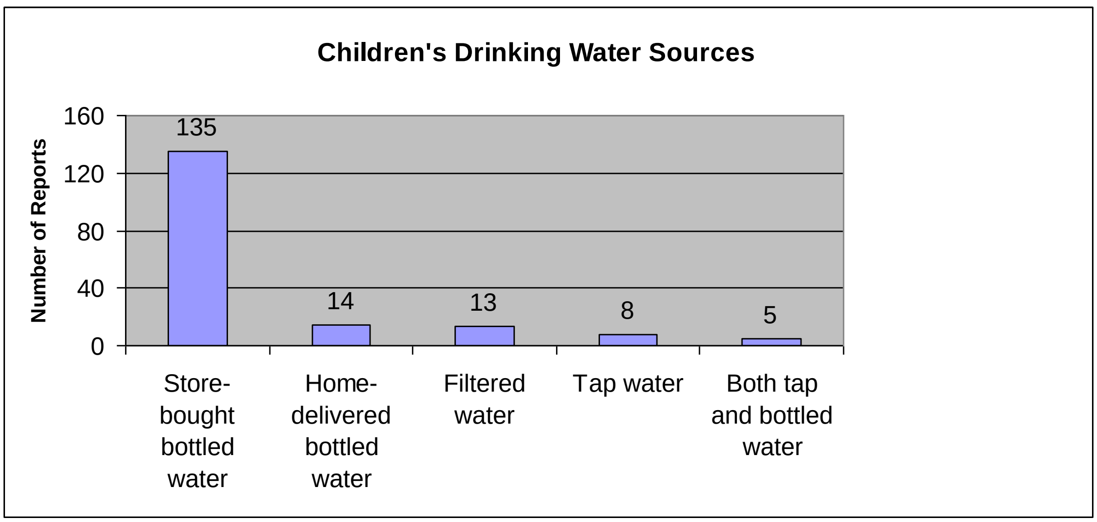

Figure 16

After seeing photos of the various candy types, respondents reported that 36 of the participants did not consume any of the categories shown in the photos. Therefore 78% of the participants had consumed at least one of the nine candy types quizzed in the study. These candies were reported to be found in many places; in fact most respondents gave multiple responses for a total of 361 places (Figure 17). There was no response to the question about places candies can be found for 23 children.

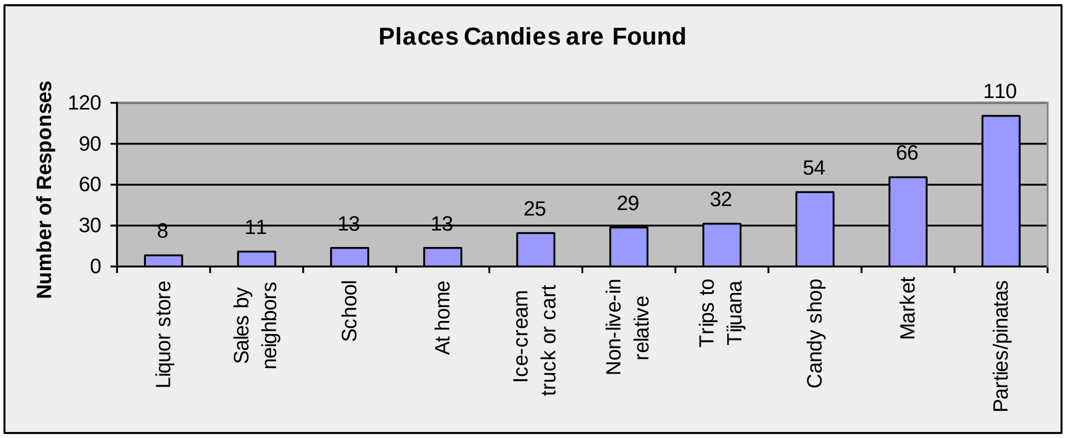

Figure 17

It was reported that 79 children had never suffered from *empacho* or colic, while 84 children had suffered from it and no answer was given for three children; see Figure 18. The majority of the children (77) had suffered from *empacho* less than three times in their lives.

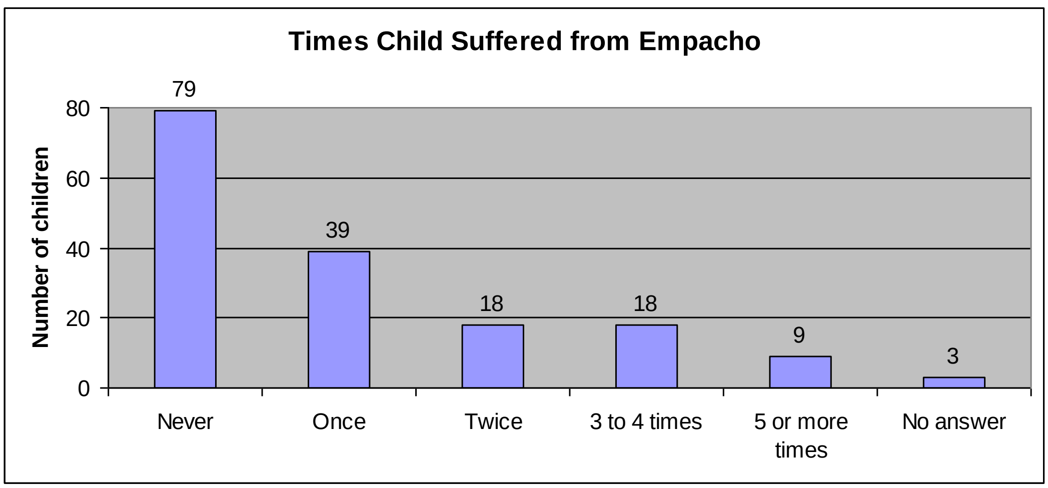

Figure 18

After a photo of different types of herbal remedies (see Annex) was shown to the respondent, only seven respondents stated that they recognized at least one of the remedies. In all a total of eight remedies were identified and named eight times as *Azul*, *Azul Añil*, *Azul* "something", *Polvo Azul* (three times), *Azafrán*, and *Azarcán*. One respondent was able to identify two different remedies. All study respondents stated that they had never used any of the remedies. All of the respondents were asked where the home remedies could be found regardless of whether they were able to identify any of the remedies. It appears that the remedies can be found almost equally in both Mexico and California. The vast majority did not know where to find home remedies, but some respondents gave multiple answers, resulting in a total of 29 responses. Of the 23 responses to this question, Mexico was mentioned 15 times as a source and *botánicas* (herbal remedy stores) were named six times (five specifically in California and one unspecified). There were another five mentions of local/farmer's markets in California, whereas two named *curanderos* (healers) in California and one a relative.

Another important source of exposure to lead can be pica behavior by children. According to the survey respondents, 40 children (24%) sucked their thumbs or other fingers, 9 children (5%) ate dirt, and 13 children (8%) had eaten or peeled away paint within the last year.

Child Medical Care

The majority (70%) of children had current health insurance coverage through various forms of public assistance; however, 32 (19%) reported that they currently did not have any form of medical insurance and only 10 percent had private insurance (see Figure 19). Three children reported having multiple types of insurance (two per child). For only one participant could the form of health care not be determined. Even though 133 children had some form of medical insurance at the time of the study, 24 of them (18%) had been without medical insurance at some point during the previous year.

A relatively small number of the children in the study (6.6%) needed medical attention during the last year but could not receive it due to cost. Surprisingly, four of these eleven children had not been reported to have a gap in medical insurance coverage over the last year. The reason for their failure to receive medical care is unknown.

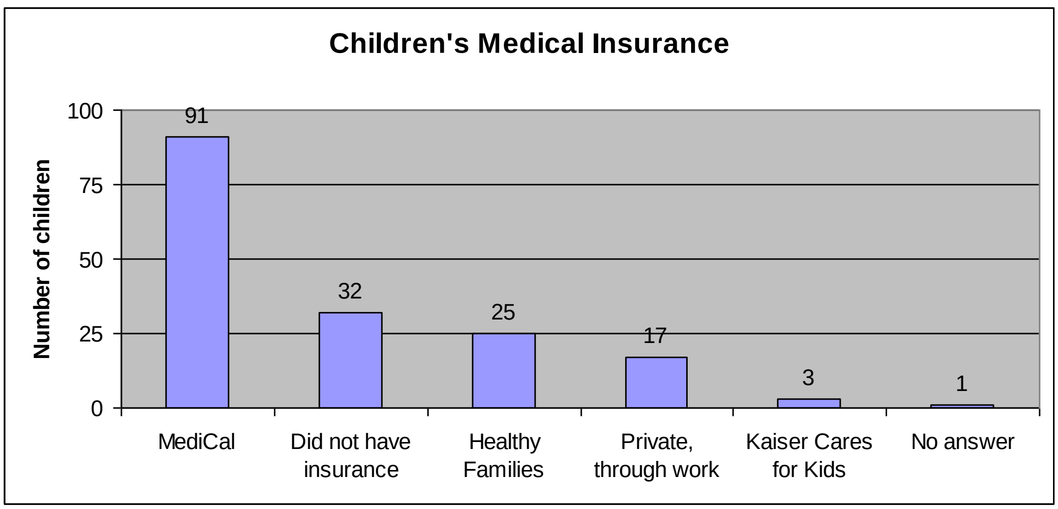

Figure 19

Various strategies to obtain medical care were reported for the 32 children who did not have any form of medical insurance during the previous year, yet required medical attention. In seven cases, medical care could not be afforded, even though the children needed it. Of the remaining 25 children, twelve received multiple types of health care (Figure 20).

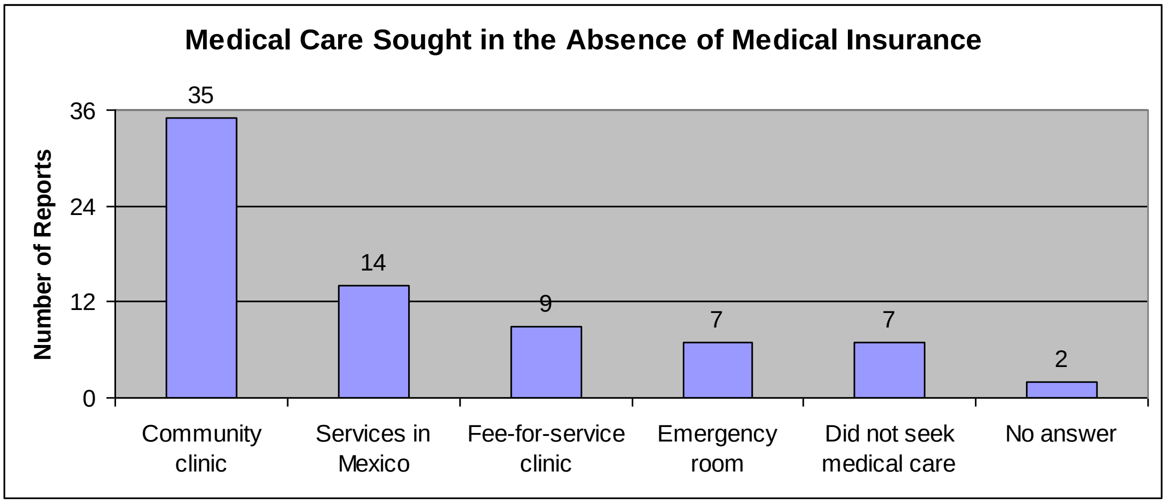

Figure 20

Child Blood Lead Testing

80% of the respondents reported whether the child participant had received a blood lead test within the last year, while 20% did not know. It was stated that 40% of the child participants had received a blood lead test and 39% had not.

The phlebotomist successfully drew blood in 116 cases on the first visit, 16 on the second visit, 7 on the third, and 7 on the fourth. For a single case, the phlebotomist made nine visits before successfully administering the test. Failures to draw blood included two refusals after 3 and 4 visits, respectively, and one instance where the family moved shortly after participating in the main study. The overall success

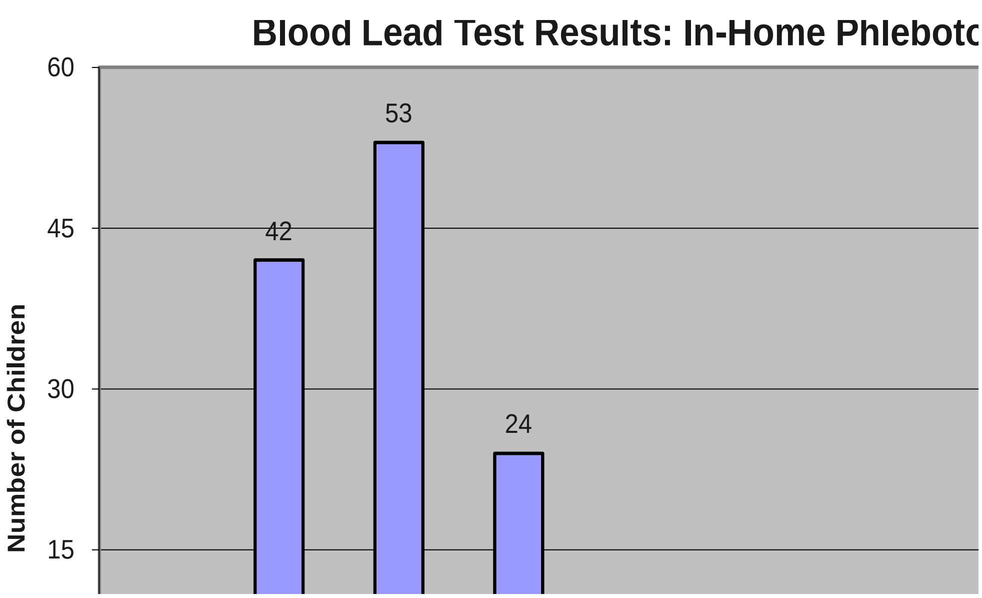

Figure 21. In-Home Phlebotomy Test Results

rate for in-home phlebotomy was 89%. Of the 19 children who did not participate in the blood testing, in one case the child moved away before testing and in seven, the parent/guardian consented to share recent blood lead test results from their pediatricians. These results were all less than 3 µg/dL and are not included in Figure 21.

Of all the children tested, 14 (9%) had blood levels between 5 µg/dL and 9 µg/dL and there were no cases of levels equal to or above 10 µg/dL. Seven results were reported as <1 µg/dL; these results are represented in the histogram by the bar labeled zero. Households (twelve in all) containing children with blood lead levels in excess of 5 µg/dL were eligible for and subsequently enrolled to receive City of San Diego lead remediation services, on the basis of these results.

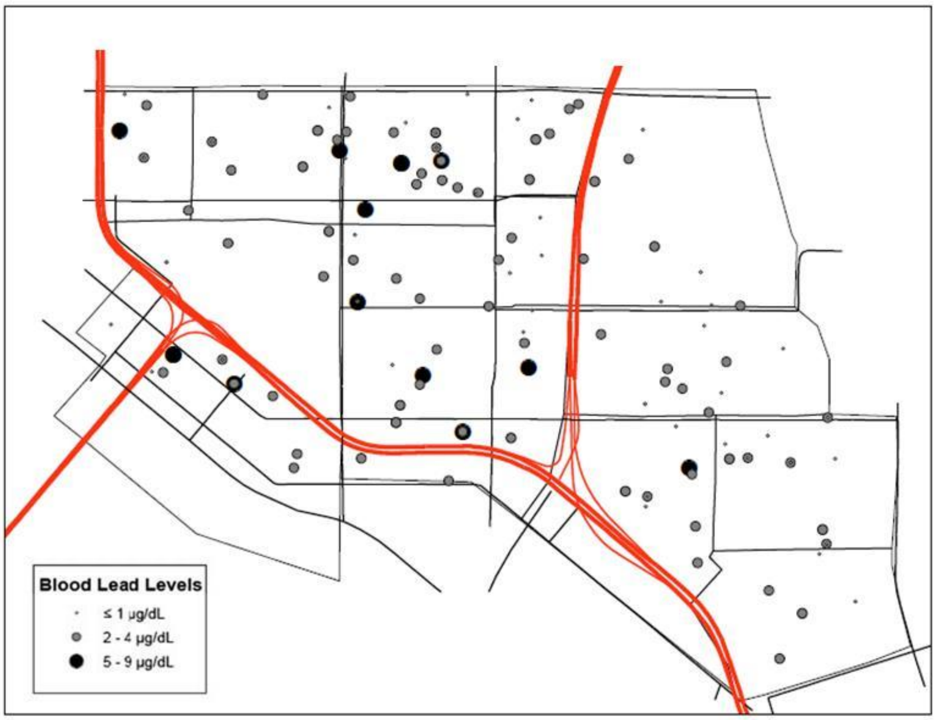

Figure 23. Geospatial Distribution of Blood Lead Levels

Figure 23 shows the study area with the geographic distribution of the blood lead results, with overlain freeways and census tracks.

Environmental Samples

The environmental sampling performed was another mechanism for study participants to receive lead remediation services, if any of the standards that applied at the time of the study were exceeded.

- Dust: 40 µg/ft^2 on floors and 250 µg/ft^2 on interior window sills (U.S. EPA)
- Soil: 400 mg/kg in bare soil in children's play areas (U.S. EPA)
- Paint: 600 mg/kg (U.S. Consumer Product Safety Commission)
- Water: 15 µg/L (California Department of Health Services)

Table 2. Summary of Environmental Sampling Results

Medium	**Children Sampled** (n)	**Arithmetic Mean**	**Geometric Mean**	**Maximum Value**	**Standard Exceeded** (n)
Soil (mg/kg)	161	147.8	82.6	1165	12
Paint Chips (mg/kg)	122*	1893	78.0	103,800	16
Dust – Entryway (μg/ft^2)	163	8.0	3.8	78.0	11
Dust – Sleeping Area Windowsill (μg/ft^2)	122	23.8	11.1	404	1
Dust – Sleeping Area Floor (μg/ft^2)	41	4.8	1.9	38.9	0
Water (μg/L)	165	1.1	0.7	5.53	0

*In six cases, two paint samples were taken.

Table 2 presents results in terms of the 166 study participants, indicating the number of children to which the various samples applied, since in some cases a single sample (*e.g.*, an entryway dust sample or a water sample from the kitchen sink) applied to several children in multiple-children households. A total of 20 addresses were eligible to be enrolled for services on the basis of these results (six exceeded two standards and one exceeded three standards). Only three of these had already been enrolled based on the criterion of a child resident with a blood lead level exceeding 5 μg/dL. Thus a grand total of 29 out of 128 studied households (23%) received remediation services due to this study.

Table 3. Comparison of Paint Condition between Participating and Non-Participating Households

Paint Condition and Severity	**Participant Households** (n = 126)		**Refusal Households** (n =60)	
	Moderate (%)	**Severe** (%)	**Moderate**	**Severe**
Peeling	82 (65%)	24 (19%)	31 (52%)	14 (23%)
Chipping	14 (11%)	9 (7%)	5 (8%)	5 (8%)
Chalking	27 (21%)	0	9 (15%)	2 (3%)
Cracking	59 (46%)	8 (6%)	25 (42%)	6 (10%)

Data was collected on paint conditions in the exterior of the houses visited, including for non-participants. Only 17% and 20% of houses were judged to have intact paint in the case of participating versus non-participating households, respectively. Specific details of the type of paint deterioration are shown in

Table 3 and show little difference; although the participant households had somewhat higher levels of moderately degraded paint, they had somewhat lower levels of severe decay.

CHILD CANDY CONSUMPTION ANALYSIS

There are numerous Mexican candy products available on the market but they are ever-changing; even well-known brands frequently modify their appearance, labeling and size. For this reason, we decided to group candies into nine different categories and to identify a typical weight for each. Respondents were shown photos of each of the nine types and quizzed as to which their children/wards consumed. For each type they were probed as to how often consumption occurred and during what period of time (e.g., twice daily, once weekly, etc.), as well as how many units and what type of unit (piece, bar, teaspoonful, pinch, etc) were consumed. They had the possibility to answer positively to all nine categories. Frequency was then calculated by dividing the tallies of consumption events by the corresponding time periods and then summed over the nine possible categories for a total measure (days^{-1}).

Table 4. Description of Candy Categories

Candy Type	**Photo**	**Typical Weight** (g)	**Examples**
Lollipop	A	40	Indy Marimbas, Sonrics Mega Fruit Mango Enchilado, Paleton con Chili "Teco", TamaRoca, Bolirindo, Betamex
Regular Bar	B	40	Chaca Chaca Dulce de Tejocote Salado y Enchilado, TamaRoca, Dulmex Rollito de Tamarindo, Dulmex Bolirindo Dulce de Tamarindo Acidulado, Tablarindo
Small Bar	C	16	De la Rosa Pulparindo Dulce de Tamarindo, Tamaroca, Indy Dedos, Vero Rellerindos, Tiramindo, Serpentinas, Diablitos
Small Balls	D	6	Dulces Vero PicoGoma, Sonrics RokaBola
Squeeze Bottles	E	32	Gusano Lucas Dulce de Tamarindo Liquid Candy, Lorena Pelon Pelo Rico, Lucas Gusano
Spoons	F	30	Cucharindo, Unlabeled Plastic Spoons
Chamoy Bags	G	35	Cisme Tamarind Pulp, Rago Chamoy, Hola
Clay Pots	H	150	Dulces Karla, Unlabeled Clay Pots
Shaker Bottles	L	30	Super Lucas Chile en Polvo para Sazonar, Lucas Acidito Spicy! Chili Mix Chile en Polvo, Lucas Limon, Baby Lucas, Picositos

The next step was to convert frequency data into a final measure of daily consumption (grams/day). Mothers often reported children consuming quantities that were not related to the way the product was packaged (i.e., instead of a "piece" they reported a "bite"). To convert these popular measures into gram quantities, several assumptions were necessary:

- a pinch (*puntito*) represents 1/16 teaspoon or 0.3 grams,
- a teaspoon (*cucharita*) represents 3.15 grams for a substance with a density of 0.64 g/ml such as raisins or dates, but a heaping teaspoon, *i.e.*, 5 grams, was deemed more appropriate,
- a tablespoon (*cuchara*) equals 9.46 grams but a heaping teaspoon, *i.e.*, 15 grams, was deemed more appropriate and
- "bites" (*mordidas*) and "tastes" (*probadas* or *probaditas*) reported by some respondents were defined as 7 grams per Fisher and co-workers' results (2003) with pre-school children from 3 to 5 years of age.

Usual gram quantities were assigned to each type of candy, to serve for consumption reported as a "piece" of candy or fraction thereof (see Table 4). In the case of each category for which consumption was reported, then, a gram quantity per day was calculated and these quantities were in turn summed across all of the categories for a total quantity consumed (grams/day).

Table 5. Descriptive Statistics for Candy Consumption in Study Subjects (n=166)

Variable	Mean (Std. Error)	95% Conf. Interval	Median	Range
Candy Categories Reported Consumed	2.1 (0.13)	[1.8, 2.3]	2	0 – 8
Frequency (d^{-1})	0.16 (0.02)	[0.11, 0.20]	0.03	0 – 2
Quantity (g/d)	3.8 (0.50)	[2.8, 4.8]	0.8	0 – 39

Three variables (Table 5), representing the total number of candy categories consumed, overall frequency of candy consumption of any type, and total gram quantity of candy consumed, were then included as variables in the multivariate regression analysis (below). Descriptive statistics for frequency of candy consumption of any type, and total gram quantity of candy consumed were further stratified by age (Table 6).

In addition to the quantity of candy consumed, it is useful to know the lead concentration in the candy. However, this project did not include any chemical analysis of lead due to its limited budget as well as its cross-sectional nature which precluded collection of candy and analysis over time. In order to provide a rough estimate of actual lead exposure, then, quantitative estimates of lead levels in candy were sought to serve as a guide. The State of California had begun testing Mexican candies for lead in 1993 and the passage of Assembly Bill 121 in 2005 greatly stimulated its candy testing program, which began in earnest in 2007.

Table 6. Descriptive Statistics for Candy Consumption by Study Subjects, Stratified by Age

Age (yrs)	**Number** (children)	**Mean (Std. Error)**	**95% Conf. Interval**	**Median**	**Range**
Frequency of Consumption (d^{-1})					
1 to < 2	29	0.036 (0.013)	[0.009, 0.063]	0	0 - 0.29
2 to < 3	34	0.059 (0.017)	[0.023, 0.094]	0.030	0 - 0.50
3 to < 4	36	0.24 (0.074)	[0.092, 0.39]	0.030	0 - 2.2
4 to < 5	36	0.22 (0.053)	[0.12, 0.33]	0.10	0 - 1.7
5 to < 6	31	0.21 (0.042)	[0.12, 0.29]	0.13	0 - 0.83
Consumption Quantity (g/d)					
1 to < 2	29	0.71 (0.34)	[0.019, 1.4]	0	0 - 9.2
2 to < 3	34	1.2 (0.38)	[0.47, 2.0]	0.30	0 - 10.9
3 to < 4	36	5.7 (1.6)	[2.4, 8.9]	1.1	0 - 39
4 to < 5	36	4.7 (0.89)	[2.9, 6.5]	2.3	0 - 18
5 to < 6	31	6.2 (1.3)	[3.6, 8.9]	4.5	0 - 30

Results for lead in candy tested by the California Department of Public Health (CDPH) from 2007 to July 2010 were obtained from its Food and Drug Branch (FDB) and are summarized in Table 7. The limit of detection was reported as 0.05 µg/g (Schlag, 2010). All samples reported as “ND” (non detectable) were assigned the value of 0.025 µg/g (an average between the limit of detection and zero), for the purpose of calculating summary statistics. CDPH did not analyze candy during 2006; additionally data prior to 2005 was not included because analyses were conducted by an external laboratory in addition to the FDB and reliable information on detection limits was not available.

Mexican candies were individually sorted out by name (see Table 4 for typical examples), supported by Internet searches when necessary to distinguish ambiguous Asian names (*e.g.*, Amira). FDB analytical results provided in Table 7 include candies identified as Mexican, as well as all candies tested (as a comparison). It is interesting to note that these results show little to no difference in lead levels for Mexican candies versus all candies together. Only the 2008 data indicate a slight elevation in lead levels for Mexican candies.

Table 7. Descriptive Statistics for State of California Candy Analyses

All Candy	2010	2009	2008	2007
n (analyses)	850	678	1279	600
Non-detectable (%)	95	94	93	86
Range (µg/g)	0.025 - 0.60	0.025 - 0.68	0.025 - 0.90	0.025 - 0.480
Arithmetic Mean (µg/g)	0.032	0.032	0.037	0.040
Confidence Interval (µg/g)	[0.029, 0.035]	[0.029, 0.035]	[0.033, 0.041]	[0.036, 0.044]
Geometric Mean (µg/g)	0.027	0.027	0.029	0.033

Mexican Candy	2010	2009	2008	2007
n (analyses)	211	350	324	598
Non-detectable (%)	92	93	85	86
Range (µg/g)	0.025 - 0.10	0.025 - 0.254	0.020 - 0.90	0.025 - 0.48
Arithmetic Mean (µg/g)	0.028	0.031	0.054	0.038
Confidence Interval (µg/g)	[0.027, 0.030]	[0.028, 0.034]	[0.041, 0.066]	[0.034, 0.041]
Geometric Mean (µg/g)	0.027	0.028	0.032	0.030

Table 7 shows relatively little variation among the summary statistics for the Mexican candy lead concentrations across the four years of data obtained. Still, two scenarios were examined for the calculation of dietary lead uptake due to Mexican candies: an average value and an extreme. First, a single average value across the four years of testing data, derived from the calculated geometric means, was used: 0.029 µg/g. In addition, the highest upper confidence value was considered, to represent an extreme (from the 2008 data: 0.066 µg/g). Two scenarios from the Table 6 consumption data were also considered: applying median candy consumption levels versus the upper confidence levels of consumption. All scenarios were stratified by age and appear in Table 8. Combining the two most extreme scenarios for both lead levels in candy and candy consumption, it was found that lead exposures from Mexican candies could hypothetically reach a maximum 0.1 to 0.6 µg/day, depending on age.

Table 8. Dietary Lead Intake due to Candy Consumption in Study Subjects

Age	1 to < 2	2 to < 3	3 to < 4	4 to < 5	5 to < 6
SCENARIO I: Median candy consumption across each of the five ages multiplied by the overall geometric mean of lead concentration (0.029 µg/g)					
Median Candy Ingestion (g/day)	0	0.30	1.1	2.3	4.5
Dietary Lead Intake (µg/day)	0	0.0087	0.032	0.067	0.13
SCENARIO II: Upper confidence level of candy consumption across each of the five ages multiplied by the overall geometric mean of lead concentration (0.029 µg/g)					
Upper Confidence Interval of Candy Ingestion (g/day)	1.4	2.0	8.9	6.5	8.9
Dietary Lead Intake (µg/day)	0.041	0.058	0.26	0.19	0.26
SCENARIO III: Median candy consumption across each of the five ages multiplied by the highest upper confidence level of lead concentration (0.066 µg/g)					
Median Candy Ingestion (g/day)	0	0.30	1.1	2.3	4.5
Dietary Lead Intake (µg/day)	0.00	0.020	0.073	0.15	0.30
SCENARIO IV: Upper confidence level of candy consumption multiplied by the highest upper confidence level of lead concentration (0.066 µg/g)					
Upper Confidence Interval of Candy Ingestion (g/day)	1.4	2.0	8.9	6.5	8.9
Dietary Lead Intake (µg/day)	0.092	0.13	0.59	0.43	0.59

Pharmacokinetic Analysis

Hypothetical dietary intake of lead calculated as shown in Table 8 was entered into the Integrated Exposure Uptake Biokinetic model (IEUBKwin v1.1 build 11, USEPA) to predict resulting blood lead levels (Table 9). The same scenarios were employed as for Table 8. Dietary intake was entered using the modeling option, "alternate exposure pathway", with the default value of 50% for gastrointestinal uptake and bioavailability. Default values for all other parameters (air, diet, water, soil/dust, and maternal exposure) were left unmodified. Baseline blood lead concentrations were generated by running the model using all the default values as a basis of comparison. Changes in blood lead levels (ΔBLL) were calculated by subtracting the baseline values from those with the alternate exposure pathway (*i.e.*, Mexican candy consumption) included.

Table 9. IEUBK Estimated Blood Lead Levels (μg/dL)**, Taking into Account Candy Consumption**

Age	1 to < 2	2 to < 3	3 to < 4	4 to < 5	5 to < 6
IEUBK Default BLLs	**3.5**	**3.2**	**3.0**	**2.5**	**2.1**
SCENARIO I					
Estimated BLL	3.5	3.2	3.0	2.5	2.2
Change in BLL	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**
SCENARIO II					
Estimated BLL	3.5	3.2	3.1	2.5	2.2
Change in BLL	**0.0**	**0.0**	**0.1**	**0.0**	**0.1**
SCENARIO III					
Estimated BLL	3.5	3.2	3.0	2.5	2.2
Change in BLL	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**
SCENARIO IV					
Estimated BLL	3.5	3.2	3.1	2.6	2.2
Change in BLL	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**

Interpretation

The hypothetical predicted contribution of Mexican candy to blood lead, based on the State of California candy analysis results and the IEUBK model, never exceeds 0.1 μg/dL, and then only for the older children of the study, between 3 and 5 years of age. This analysis suggests that Mexican candy sold in California is a minor exposure source for these children. It should be noted that another potential exposure source could be candy purchased over the border in Mexico, which does not form part of the CDPH candy analysis program. Such candy, produced for the Mexican domestic market and potentially with less quality control than candy intended for export, could contain higher lead levels.

Multivariate Regression Analysis

Sampling

The cluster sampling approach, *i.e.* the inclusion of all eligible children found to be living in randomly selected households, was adopted because it would have been culturally inappropriate and distressing to the children's parents/guardians to randomly select a single child from a multiple-child household. However, this led to the problem of correlated data from children of the same household. For the initial cross-sectional analysis, we did a second random sampling. That is, within each household, we randomly selected one child to be included in a log-linear regression analysis, which reduced the data set from 166 to 128 data points. We then coded each data point as to whether it came from a single-child or multiple-child household. In so doing, we discovered significant differences in the dependent variable between the two types of households. This led us to conclude that such an analysis approach would be inadequate and to subsequently adopt the Generalized Estimating Equations (GEE) approach (see below) to account for the clustering effect of multiple children per households.

Data Entry and Coding for Analysis

Questions and observations (gathered via the study instruments shown in the Appendix) were coded as individual variables in Excel, with some exceptions described in the following paragraph. Variables were dichotomous (*e.g.*, Mexican citizen: yes or no), categorical (*e.g.*, degree of paint cracking: slight, moderate, severe), or continuous (*e.g.*, number of days spent in Mexico during the previous year). Environmental (soil, dust wipe, paint chip and water) and blood laboratory analysis results were added to the Excel database as continuous variables.

Several variables represented aggregated information from multiple questions; these were primarily the special cultural exposure variables regarding Mexican candy and pottery use. They were formulated as frequencies (use of a product per given time period). Mexican candy consumption, both as number of categories reported consumed and daily quantity consumed (as shown in Table 5), was also included.

In some cases for questions with one primary response and several additional uncommon responses (in the low percentage range), variables were coded dichotomously as the dominant response (*e.g.*, mother self-identified as Mexican versus all other responses: Latina, Mexican-American, etc.). In others, indicator ("dummy") variables were formed, *e.g.*, the question for language spoken at home included five responses (exclusively or partially Spanish, exclusively or partially English or both) which were then coded using exclusively Spanish as the null. Variables for environmental assessment of the home environment were generally coded as a logical series of 0, 1, 2 (e.g., mildly/moderately/severely dusty). In all cases the variable value that was expected to contribute the least amount of lead exposure was set as the base comparison value (0); e.g., the child has not been observed to eat paint.

Variable Screening

To adequately address the clustering issue and simultaneously maximize the use of collected data, we selected the GEE model (SAS version 9.2). To prepare for a multiple-predictor GEE analysis, we first conducted variable screening using single predictor GEE models of the log-transformed dependent variable, blood lead level (µg/dL), along with each of the potential predictors. We ran 81 regressions and selected those with a substantial slope estimate (ß typically greater than 0.15 per unit change in the independent variable) and p-value <0.20. The most important results are shown in Table 10.

Table 10. Univariate Screening as a Prelude to Model-Building

Variable Code	Description	Type	Slope Estimate	St'd Error	χ^2 Value	Signif. Level
MAIN EFFECTS of INTEREST						
cndygrpd	Candy consumption (g/d)	continuous	0.0162	0.0074	3.35	0.067
tcndyfrq	Frequency of child candy consumption (day^{-1})	continuous	0.3218	0.1412	4.73	0.030
duelabr	Home entryway dust analysis (mg/kg)	continuous	0.0026	0.0045	3.16	0.076
soilabr	Play area soil analysis (mg/kg)	continuous	0.0007	0.0003	5.14	0.023
POTENTIAL CONFOUNDING VARIABLES						
chldsex	Male child	dichotom.	0.2611	0.0922	7.56	0.0060
chldage	Child's age (days)	continuous	-0.0002	0.0001	3.78	0.052
hinsurpr	Child is privately health insured	dichotom.	-0.4053	0.1532	4.59	0.032
nodoc	Child did not receive necessary medical attention, previous year	dichotom.	0.4393	0.1682	4.36	0.037
DEMOGRAPHIC FACTORS						
momidend	Mother self-identifies as Mexican	dichotom.	0.1801	0.1125	2.28	0.13
dadschls	Father's schooling	categorical	-0.0813	0.0601	1.69	0.19
momschls	Mother's schooling	categorical	-0.0847	0.0547	2.14	0.14
ownrshpd	Residence owned	dichotom.	0.2187	0.1186	3.28	0.070
CHILD BEHAVIOR						
suckthm	Child sucks thumb	dichotom.	0.1978	0.1245	2.25	0.13
eatpnt	Child observed eating paint, previous year	dichotom.	0.2958	0.1474	3.08	0.079

ENVIRONMENTAL SOURCES						
pntsmpld	Peeling paint sampled in home environment	dichotom.	0.1488	0.0962	2.34	0.1258
ptexpeel	Peeling paint observed in home exterior	dichotom.	0.1437	0.0729	3.50	0.0613
extdweld	Wooden dwelling exterior	dichotom.	0.1404	0.0990	1.96	0.16
dustflrs	Dustiness of child sleep area	categorical	0.1239	0.0774	2.45	0.12
nowkhobb	Number of lead-asso-ciated household activities	continuous	0.0980	0.0566	2.26	0.13
CHILD MOBILITY						
gonemex	Child traveled to Mexico, previous year	dichotom.	-0.3123	0.0971	8.88	0.0029
outsydwe	Time child spends outside, typical weekend day (hrs)	continuous	-0.0337	0.0182	2.81	0.094
noplawh	Number places child spends away from home	categorical	-0.1246	0.0757	2.09	0.15
ttlhrawh	Time child spends away from home (hrs/wk)	continuous	-0.0037	0.0024	1.72	0.19
livareal	Child lived entire life in study area	dichotom.	0.2134	0.1081	3.76	0.053
livhousl	Child lived entire life in house visited	dichotom.	0.2064	0.1046	3.61	0.057

Multi-level Modeling via Multiple Predictor GEE Models

To perform the multilevel GEE modeling, the following options were selected: the log-transformed blood lead level was the dependent variable, the data distribution was normal, identify function was link and the correlation structure was compound symmetry. Predictors were selected based on the univariate analyses but also taking into account co-linearity. For example, 'cndygrpd' and 'tcndyfrq' were highly correlated as were 'livhousl and livareal'. The variables chosen for modeling, then, were 'cndygrpd' and 'livhousl' as they are more explanative. Also, 'momschls' and 'dadschls' were correlated, but 'momschls' was chosen for its higher slope estimate and higher statistical significance.

Table 11 summarizes the variables examined. First the effects of interest were entered as a group (see Table 12, Model A), then the variable for dust lead concentration was removed as it was found to be unimportant. Next, possible confounding variables were tested by adding them into Model A: child age and sex as well as access to medical care. Evidence of confounding of candy consumption was observed, using the change-in-parameter > 10% rule. Child age and gender and private health care coverage were all found to be important predictors in their own right, although 'nodoc' was not retained (Model B, Table 12). Other important variables were tested in groups according to four remaining themes as presented in Table 11, independent of the Model A variables.

Table 11. Thematic Variable Grouping

Variable Group	Variable Names
Main effects of interest	cndygrpd duelabr soilabr
Possible confounders	chldage chldsex nodoc hinsurpr
Demographic factors	momidend momschls dadschls ownrshpd
Environmental sources	ptnsmpld ptexpeel extdweld dustflrs nowkhobb
Child behavior	suckthm eatpnt
Child mobility	gonemex outsydwe noplawh livhousl

Of 15 variables in the four remaining thematic groups, only three were found to be significant predictors of blood lead level, two from the group representing child mobility (‘gonemex’ and ‘livhousl’) and one from child behavior (‘eatpnt’). These were added to produce Model C (Table 12), but none retained their significance in the larger model. They scarcely influenced the slope estimates of the previous model (B) although the significance levels of several of the other variables were reduced. Finally, we tested the following potential effect modifications: candy consumption by age, soil lead contamination by age and candy contamination by child sex. There was no evidence of effect modification in this data set. We then reverted to model B as the best, albeit parsimonious, explanation of our data.

Table 12. Model Building

Variable	BLL Multiplier	Slope Estimate	St’d Error	Confidence Interval	χ^2 Value	Significance Level*
A. INITIAL MODEL – QIC=146, QICu=148						
Candy consumption (g/day)	1.02	0.018x	0.0074	[0.0031, 0.032]	3.71	0.054
Soil concentration (100 mg Pb/kg)	1.07	0.070x	0.027	[0.017, 0.12]	4.04	0.044
Dust concentration (100 mg Pb/kg)	1.24	0.22	0.24x	[-0.25, 0.69]	0.93	0.33

B. MODEL with POTENTIAL CONFOUNDERS – QIC=151, QICu=153						
Candy consumption (g/day)	1.02	0.023	0.0080	[0.0071, 0.038]	5.82	0.016
Soil concentration (100 mg Pb/kg)	1.07	0.067x	0.026	[0.017, 0.12]	5.30	0.021
Child age (years)	0.92	-0.080	0.030	[-0.14, -0.022]	6.26	0.012
Male child	1.25	0.22	0.089	[0.048, 0.40]	5.84	0.016
Child is privately health insured	0.64	-0.44	0.14	[-0.72, -0.17]	5.52	0.019
C. MODEL with ADDITIONAL IMPORTANT PREDICTORS – QIC=151, QICu=155						
Candy consumption (g/day)	1.02	0.020	0.0077	[0.0054, 0.0355]	4.79	0.029
Soil concentration (100 mg Pb/kg)	1.05	0.049	0.027	[-0.0027, 0.1012]	3.15	0.076
Child age (years)	0.94	-0.062	0.030	[-0.1207, -0.0041]	4.04	0.045
Male child	1.27	0.24	0.089	[0.063, 0.41]	6.70	0.010
Child is privately health insured	0.70	-0.36	0.14	[-0.64, -0.0858,]	4.8	0.029
Child eats paint	1.27	0.24	0.10	[0.042, 0.44]	3.63	0.057
Child traveled to Mexico, previous	0.81	-0.21	0.11	[0.0070, -0.43]	3.35	0.067
Child lived entire life in house visited	1.17	0.16	0.095	[-0.024, 0.35]	2.77	0.096

Final Model

Based on the previous model-building process, we chose Model B as the final model for lead exposure:

ln (blood lead level) ~ cndygpd + soilabr + chldage + chldsex + hinsurpr

For the GEE model, it is not possible to construct a likelihood; instead a quasi-likelihood is constructed in the form of the QIC and QICu criteria developed by Pan (2001). These are analogous to the Akaike information criterion). For the purpose of judging model goodness of fit, a smaller value of the QIC or QICu is more desirable. These values are included in Table 12 for reference.

Interpretation

The GEE slope estimates in Table 12 were back-transformed to give values that represent the average change in blood lead level per unit change in the predictor variable (represented as "BLL Multiplier"). The default value is one, representing no change; values greater than one indicate BLL increases and values less than one, decreases. Thus we found that Mexican candy consumption is associated with a modest but statistically significant increase in blood lead level. The same is true of soil lead levels, in which a 100 ppm (mg/kg) increase translates to a five percent increase in BLL. However, dust lead levels, when tested along with these two variables, did not show an important effect and this variable was removed from the model.

To translate the candy consumption result into practical terms, we can turn to our Mexican candy consumption survey, where we saw that the younger children in our study consume on the order of one gram candy daily but the older children average some six grams per day. Using the GEE model for prediction purposes and controlling for all the other variables, these values would translate into increased blood lead levels of roughly 2% to 15%, respectively. To provide a practical basis of comparison, for the median BLL of 2 µg/dL found in this study, this would translate into an increase to 2.3 µg/dL for the older children.

As part of this study, since no candy was collected or tested for lead concentration, we cannot know the exact direct contribution of lead from this source. Thus, although it is possible that this association between candy and elevated blood lead levels is directly due to lead contamination of candy, there is an alternative explanation, which is that Mexican candy use is simply a marker for something else. One possible example could be that candy consumption is an indication of the child's nutritional status (e.g., higher consumption might correlate with a diet deficient in iron and calcium, which are necessary to decrease lead absorption in exposed children).

Male children showed a BLL multiplier of about one quarter higher than girls. Age, as expected, also is a significant predictor of lead exposure (with BLL dropping about 8% annually as a child ages from 1 to 6 years). Finally, one of the variables measuring access to medical care, private insurance coverage, was an important predictor of BLL, demonstrating a strong protective effect. This variable, when corrected for the other variables in the model, is associated with a lowering by one third of the blood lead level.

DISCUSSION

Prevalence

This study of Latino children demonstrates a 9% prevalence of blood lead levels at or above 5 µg/dL, which is more than double the prevalence for all children in San Diego County (CDPH data presented in Table 1); however the age ranges are slightly different (1-5 years inclusive in the current study versus 0-5 years inclusive in the CDPH surveillance data). Thus the CDPH data include one more year, but given that surveillance commonly begins at age 1, the age category of less than one year old should not represent a large number of children. At any rate, disregarding this potential additional children in the CDPH data would tend to further accentuate the difference with the prevalence estimate of the current study.

No children with BLLs of 10 µg/dL or above were captured in this study; the sample size was not sufficient to detect prevalences this low (less than one percent per Table 1). To provide further summary statistics for the current study, the median value for the children tested was 2 µg/dL, while 15% exceeded the level of 3 µg/dL and 70% had values above 1 µg/dL. The geometric mean was 1.9 µg/dL (values reported as <1 µg/dL were averaged between one and absolute zero, i.e., 0.5 µg/dL). When stratified by gender, values are 1.7 for girls (n=84) and 2.2 µg/dL for boys (n=61). The results of this study followed usual trends in that BLLs tend to decrease with age and are lower for girls than boys.

National data are available from the NHANES; the most recent data (CDC, 2009) is for the 2003-2004 period, slightly preceding the current study. Values are geometric mean estimates for the entire U.S. population (meaning both genders, all races/ethnicities and all age groups) that are then subdivided into large groupings that do not match the specific category of Latino children. The subcategories pertinent to the current work are the 1- to 5-year age group: 1.77; males: 1.69; females: 1.22 and Mexican-Americans: 1.55 µg/dL. Further analysis by Jones et al. (2009) covered the entire period of NHANES 1999-2004 and included results specific for Mexican-American children aged 1 to 5 years, indicating a geometric mean of 1.9 µg/dL with prevalence values of 4.7% (for the 5 to <10 µg/dL range) and 1.2% (for values of 10 µg/dL or greater).

More specific work has been done on children in other counties bordering Mexico, although not specifically for Latino children. In 1998 and 1999, Cowan et al. (2006) measured the blood lead levels of children from a convenience sample (at medical and educational venues) in Arizona and New Mexico border counties, of the same age as the current study. They obtained the following results: 3.1 (Yuma County), 1.5 (Grant County) and 1.7 µg/dL (Luna County).

Candy Consumption

Dietary consumption would ideally have been measured prospectively with tools such as food diaries to record each meal and kitchen scales to weigh portion size. Many dietary surveys that are self-administered, however, rely on participant recall over the last several weeks or months. This approach is impossible with small children, of course, so we queried “typical” current consumption frequency and quantity, relying on photographs of candy types to aid respondent recall. We used vernacular and culturally appropriate terms, e.g. *puntito* (pinch), that mirror the way that laypeople commonly think about serving portions. Respondents were primary caregivers and since all children were too young to be attending school (other than some kindergartners), it is likely that they would have a fairly comprehensive view of what the children were consuming. One possible exception would be children spending fair amounts of time outside the home (with relatives or at daycare or kindergarten) and a more comprehensive approach would be to include these additional caregivers in the survey.

Actual testing of lead in candies purchased by study participants would be ideal, but would be difficult to accomplish without a prospective component in which candies were collected over time, entailing additional expense. Our calculations based on the FDB testing program indicate that Mexican candies purchased within the state are not sufficiently lead-contaminated to cause more than a modest increase in child BLLs. It might be useful to include in future questionnaires a query on where the candies were bought, as candies purchased in the domestic Mexican market potentially could be more lead-contaminated.

Cultural Exposures

No respondents reported using Mexican home remedies and a surprisingly low percentage, representing 18% of the children, reported using Mexican clay pottery for cooking or serving food. The literature review by Lynch et al. (2008) on such reports in Mexico concludes that they range from roughly 40 to 80%. Such practices certainly continue when Mexicans immigrate to the U.S. but this study would seem to indicate that the rate of pottery use is dramatically lower. Although Mexican pottery is definitely more expensive and less common on the U.S. side of the border, anecdotal evidence of its use abounds; child lead poisoning prevention programs in California and other states periodically include exchange programs to replace clay pots with metal ones. The focus group study conducted in preparation for the current study indicated that group dynamics are very helpful in eliciting information about ethnic behaviors. Better information on the prevalence of these practices is important, but may be challenging to collect in the context of a single contact and a rigid study questionnaire such as typically occurs in a cross-sectional study. A study design that involves multiple contacts, such that trust between the research team and study subjects can be built, is undoubtedly both advisable and more culturally appropriate, but implies a significantly increased cost. Another option might be a more anthropologic approach with broad open-ended questions about Mexican cultural practices.

From these study results it is not possible to determine whether special cultural exposures *per se* in the Latino community are driving higher lead exposures, or whether the consumption of Mexican candy is a marker for something else. It is notable that in our statistical analysis, once the candy consumption variable was entered into the model, aside from child sex and age, all other acculturation, ethnicity and socioeconomic variables "fell out", i.e., were no longer significant. As candy use is the variable that we measured most carefully and in greatest detail for our study, it is possible that it is, then, the best marker we have for Mexican ethnicity and/or acculturation to the U.S. This could be associated with lower socioeconomic status and overall use of Mexican products, some of which may contain lead.

Study Strengths

The goal of the study was to successfully recruit 150 participants; the funding limitations were the primary determinant of this modest number. We exceeded our goal, though the hit rate (13.4%) was less than one in seven when we had expected something in excess of one in six. We found less Latino children per household than during our pilot study two years before, possibly due to demographic changes in the area during that time. It was consequently necessary to conduct more household visits than planned.

Our participation rate at nearly 70% was quite good for this marginalized group, particularly considering the certainty that a portion of our respondents were undocumented (we did not ask about immigration status). Two factors are probably responsible: the study workers looked and spoke like the target study respondents, i.e., young, Spanish-speaking and primarily Latina (there was only one Latino man and one Anglo woman on the team), and were trained to present an open and approachable yet professional appearance. Culturally appropriate approaches are critical for reaching this sort of population. Secondly, presenting the study first and foremost as a project of the local university, San Diego State University, made it seem non-threatening and community based. The refusal questionnaire allowed us to determine that, by several basic measures, there was little difference between non-participants who were determined to be eligible and those who actually participated in the study.

This study pioneered a culturally-appropriate approach to measuring Mexican candy consumption in the Latino community that should be applicable to such communities throughout the state and even the country. The orientation toward visual aids (photographs of the candies), grouping into types, calculating typical serving sizes and quizzing on quantity/frequency of consumption can be expected to yield good estimates of overall consumption.

A significant outcome of this work was detailed in a publication focusing on the utility of this study's in-home phlebotomy approach (Dowling *et al.*, 2008). The 89% success rate for blood tests in this under-served group was substantially higher than the 50% estimate for customary screening of at-risk children through physicians provided by the California Childhood Lead Poisoning Prevention Branch (CLPPB) in advance of our study (Courtney 2005, personal communication). A preliminary Medi-Cal screening estimate recently provided by the CLPPB indicates that initial estimate may have been low. This study analyzed the RASSCLE II blood lead surveillance database for Medi-Cal enrollees whose first birthdays fell within a six-month period between April and September, 2005. Records were examined for an overlapping 18-month period in an attempt to determine how many of those children were screened. For enrolled children, blood lead screening occurred at least once in 62.6% but for children who received some Medi-Cal services, this figure rose to 76.6% (CLPPB, 2007). The door-to-screening approach of the current study would be especially useful for children who have no medical coverage at all or went without it during the past year (19% and 18%, respectively, per the current study). Children with gaps in their medical insurance would be less likely to receive diagnostic testing.

The overall cost of the in-home phlebotomy was $45 per individual blood test, including the blood analysis which was performed at cost by the County of San Diego Department of Public Health Laboratory. This compares quite favorably with the combined cost of a typical office visit plus laboratory test, and of course the effort and time required of the parent/guardian is significantly less. Employing culturally-appropriate in-home phlebotomy proved to be a useful method that could be utilized by programs seeking to meet the needs of under-served communities. Using the pertinent questions from our questionnaire (regarding lack of health-care coverage and inability to pay for medical office visits) would be helpful in targeting those least likely to receive the blood lead test through public or private medical insurance programs.

Study Weaknesses

This cross-sectional study contained a relatively small proportion of children with elevated BLL (higher than 5 µg/dL) and none with highly elevated BLL (greater than 10 µg/dL); thus it is impossible to draw conclusions about the importance of various lead sources in significantly elevating blood lead levels, i.e., at 10 µg/dL and above. As the occurrence of these higher blood lead levels is uncommon, a case-control study design would have been more appropriate than the current cross-sectional approach. For that, however, it would have been necessary to sample cases, ideally from the State of California electronic blood lead reporting database. That would have allowed us to really see what is driving blood lead elevations in this subgroup.

Measurement error is an issue in any epidemiologic study and as such must also be considered for this study, particularly with respect to the questionnaire. We did not conduct a full acculturation survey which would have generated a single quantitative measure for the multivariate analysis as opposed to the various qualitative acculturation measures that we tested separately (e.g., language spoken at home, ethnicity, etc.). Similarly, due to funding limitations, a full dietary consumption survey for products associated with lead contamination was not conducted. The candy consumption measure was the real strength of this work, but it was based on the respondent's judgment as to the child's typical candy consumption. A more careful prospective collection of data involving the caregivers (sometimes multiple) of each child over a period of several weeks would have been ideal. Such an approach could be considered for the future, although they would also lengthen the amount of effort required of study participants. A more substantial economic incentive could be provided.

Environmental sampling was conducted according to standard U.S. EPA protocols and should have been rigorous. However, paint samples were not taken when paint was not peeling. This limited the ability to include quantitative measures of paint contamination in the multivariate analysis. In addition, the fact that laboratory analysis of environmental samples was conducted by two different analytical laboratories and with two different sample digestion methodologies could have decreased the reliability, particularly of the soil and paint sample results.

RECOMMENDATIONS

RECOMMENDATION I

The California Office of Environmental Health Hazard Assessment (OEHHA), in the period since landmark multi-cohort study of Lanphear and co-workers (2005) was published, has finalized three new risk assessments for lead. This work provides an important precedent at the state, national and international levels. However, there is discordance between these risk assessments in different media governed by different statutory requirements. It is recommended that OEHHA resolve these differences in approach.

Justification: Subsequent to the Lanphear study, there has been a great deal of debate in the scientific community regarding the need to further lower the child blood lead standard. OEHHA's first related risk assessment was promulgated to address children's exposures at school sites (OEHHA, 2007; Carlisle *et* *al.*, 2009). While recognizing that "a no-effect level has not been identified", it defined a one-point IQ change as the benchmark for *de minimus* deleterious neuro-developmental effects in children. OEHHA based its analysis on a linear fit to the dose-response curve, due to the challenge of promulgating a standard based on the log-linear relationship defined by the Lanphear study. The resulting health guidance value of 1 µg/dL (blood lead concentration) is "a benchmark incremental change in blood lead concentration … for a specific location."

OEHHA went on to apply this same blood lead benchmark change of 1 µg/dL developed for the multiple-source school environment to risk assessments for single exposure sources: drinking water (OEHHA, 2009a) and residential and commercial soils (OEHHA, 2009b). The drinking water assessment additionally utilizes a relative source contribution (RSC) approach, in which this single exposure route is assumed to represent 20% of overall lead exposure sources. This is different from the approach in the soil risk assessment, which also addresses a single exposure source but does not apply a RSC.

Blood lead levels as a measure of internal dose represent the *in toto* exposure of the organism to all of the sources to which it is exposed. A consideration of multiple exposure sources is important for the treatment of individual sources of lead, a ubiquitous toxicant which is found in air, water, soil, paint, dust, foodstuffs, etc. Thus it is recommended that OEHHA consider overall blood level elevations when addressing individual exposure sources and that it do so in a way that is consistent across media.

Recommendation II

It is important that health standards be constantly updated as new scientific knowledge becomes available. The California Department of Public Health should exercise its authority under California Health and Safety Code 105300 to "[establish] lower concentrations of lead in whole blood than those specified by the United States Centers for Disease Control for the purpose of determining the existence of lead poisoning."

Justification: The Centers for Disease Control, responsible for setting the United States blood lead standard on which most states base their lead control activities, has, since 1991, declined to revisit its standard. The most recent U.S. Centers for Disease Control policy statement (CDC, 2005) explains its reasoning.

> Although there is evidence of adverse health effects in children with blood lead levels below 10 µg/dL, CDC has not changed its level of concern, which remains at levels >10 µg/dL. We believe it critical to focus available resources where the potential adverse effects remain the greatest. If no threshold level exists for adverse health effects, setting a new BLL of concern somewhere below 10 µg/dL would be based on an arbitrary decision. In addition, the feasibility and effectiveness of individual interventions to further reduce BLLs below 10 µg/dL has not been demonstrated.

In contrast, the German Umweltbundesamt (Federal Environmental Agency or UBA), while in agreement that no threshold for lead effects in children is apparent, recently decided that a new blood lead standard is justified based on the weight of scientific evidence (Wilhelm *et al.*, 2010). The UBA promulgated a standard of 3.5 µg/dL for children aged 3 to 14, calling it a population reference value that should be taken as a "concentration above which there is a need for action (in line with 'level of concern' of the CDC …)". This is a more apt approach than that of the CDC for a national agency on the issue of lead in the wake of the Lanphear study. In the absence of action at the U.S. federal level, the State of California should take its own steps to promulgate an appropriate standard.

Recommendation III

To optimize research into this important health threat for young children, it is incumbent upon the California Childhood Lead Poisoning Prevention Branch to begin to manage its RASSCLE II database with greater public transparency and allow outside researchers to access the blood lead reporting database in order to conduct health research.

Justification: The CLPPB administers the Response and Surveillance System for Childhood Lead Exposure (RASCCLE) II electronic blood lead database, which, per California Health and Safety Code Section 124130, stipulates of health laboratories: "[c]ommencing January 1, 2005, a report required by this section shall be submitted by electronic transfer. It is incumbent upon administrators of health surveillance databases, such as RASSCLE II, that represent substantial expenditures of public and private resources, to use and allow the use of such data to improve the health of the affected individuals. That implies 1) regular reporting to the public summarizing the data collected and 2) facilitating access by qualified outside researchers to the database for legitimate research purposes. Both functions 1) benefit the people of the State of California, including those whose medical records form part of the database and 2) expand the limited capability of the database administrators to examine important health issues, particularly in times of scarce resources.

For decades, health databases such as the California Cancer Registry (CCR) and California Birth Defects Registry have had procedures in place for releasing patient contact information to qualified researchers. Mechanisms are already well established by these sister databases at the CDPH to properly manage Institutional Review Board procedures and the attendant state, national and international legislation that restrict legal and ethical access to confidential health data. It is necessary that CLPPB apply these models and mechanisms to the RASSCLE II system.

Specific suggestions to improve the usefulness of the database follow. First, to properly design research studies and public health interventions, data must be reported at a lower level than that of counties, as currently presented (Table 1). Optimally this would be at the census-tract level, but even the zip-code level would be an improvement on the current situation. Second, given the well-established fact that minority children are more at risk for elevated blood lead, data on race/ethnicity is critical. The reporting database currently does not require reporting of race/ethnicity; this situation should be remedied by modifying the reporting form to include this additional information.

Recommendation IV

Conduct additional study at the state-wide level, focusing on the special exposures of minority children, in a further attempt to quantify the importance of culturally-related lead exposures.

Justification: A case-control study design is the most appropriate for rare diseases, of which blood lead levels in excess of 10 µg/dL qualify, with prevalences in the fractional percentage range. To properly probe the cause of such elevations in Latino children in California, it is necessary to identify cases and controls for such a study. By far the most accurate, quickest and most cost effective way to do so would be using RASSCLE II. Despite repeated requests at the end of 2005, however, such access was denied and the current study was instead conducted with a cross-sectional design. A recent communication from the CLPPB (Charleton, 2010) indicates "our lead data is not freely available and we do not anticipate that childhood blood lead values and associated information will be freely available to outside researchers in the proximate future. However, analyses that are important for CLPPB priorities and which will improve lead poisoning prevention and management services provided to children, may be able to be undertaken as a collaborative effort working with CLPPB". It is crucial that the CLPPB plan and conduct research studies, whether on its own or in collaboration with the appropriate experts, that are designed to further elucidate the lead exposure panorama of minority/underserved subpopulations in the state and the importance of special cultural exposures. Subsequently it is critical that the results of such studies be openly and publicly published.

Recommendation V

Explore the feasibility of a program of culturally-appropriate house-to-house phlebotomy focusing on uninsured or underinsured Latino children.

Justification: Reaching the uninsured and/or underinsured is a logistical and financial challenge. The current study indicates that over a third of the children in the present study had gaps in their health insurance coverage during the previous year, which decreases the likelihood of them having been tested properly for lead exposure. Many barriers to lead testing also exist for parents/guardians which in-home phlebotomy could overcome: lack of understanding of the importance of lead exposure in young children, uncertainty about the normal procedures for obtaining the test and logistic challenges in scheduling transportation, childcare, eldercare and/or week-day medical appointments.

By making use of elevated BLL prevalence data at the zip-code or census-tract level, as well as U.S. Census data on Latino and/or Spanish-speaking areas of California, house-to-house phlebotomy could be targeted to best utilize resources. Screening for uninsured or underinsured children could be accomplished using methods already validated in the current study. Many of these children would qualify for and could be concurrently enrolled in public health insurance programs, thereby defraying the cost of the procedure. A modest initial attempt is recommended, to pilot and refine such approaches and to determine their financial feasibility.

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APPENDIX:

STUDY INSTRUMENTS

FORM A. Participant Eligibility Script

"Good morning/good afternoon. My name is _____________ and my partner's name is _____________. We work for San Diego State University in collaboration with the State of California. We are doing a study of Latino children's health. Would you be willing to answer a quick question?"

If yes → Proceed to the next question

If no → Thank the person for his/her time. Enter the result as participation declined before determining eligibility (#4) on the *Household Tracking Log*. Proceed to the next household.

"Are there <u>Latino/Hispanic</u> children between the ages of 1 and 5 (12-71 months) living in this household?"

If yes → Proceed to the next question

If no → Thank the person for his/her time, enter the result as ineligible (#7) on the *Household Tracking Log* and proceed to the next household.

"Are you the father, mother, or guardian of the child(ren)?"

If yes → Proceed to the next question

If no → Ask when you could find one of them at home.

Enter the result as eligible without parents/guardian (#8) on the Household Tracking Log.

[Note suggested date/time of return in "Other" column of the *Household Tracking Log*.]

Proceed to the next household.

“We have determined that you have a child/children eligible for the study. Now I would like to take a few minutes to explain the study to you. After answering all your questions, I will ask you if you would like to participate. Do I have your permission to explain the study?”

If yes → Explain the study to the subject, give him/her the *Consent Form* and read it to him/her if necessary. Ask if s/he has any questions or concerns about this study. Answer all questions or concerns. If you cannot answer, contact your supervisor for assistance. Then proceed to the next question.

If no → Thank the person for his/her time, enter the result as ineligible (#5) on the *Household Tracking Log* and attempt to administer the *Refusal Questionnaire* (Form B). Proceed to the next household.

If busy → Ask if someone from the study can come back later and try to schedule a time/date. Enter the result as eligible without parents/guardian (#8) on the *Household Tracking Log*. Offer to provide a reminder call & note the first name/phone number on the reverse side of the *Household Tracking Log.*

“Now that you understand the study, would you like to participate?”

If yes → Obtain his/her signature before initiating the interview. Enter the result as eligible participant (#9) on the *Household Tracking Log*.

If no → Thank the person for his/her time, enter the result as ineligible (#5) on the *Household Tracking Log* and attempt to administer the *Refusal Questionnaire* (Form B). Proceed to the next household.

[NOTE: Be sure to complete the eligibility script for a parent or guardian of each eligible child, for cases of multiple families living in the same house.]

FORM B. Refusal Questionnaire

[For use when participant refuses to give informed consent to participate.]

Household Address: ________________________

"Thank you for your time today. Before we leave, we would like to ask you some questions to better understand why you are not interested in participating in this study. Is it all right to ask you some more questions? Remember you can choose not to answer any of these questions."

[Circle response:] Y N [Respondent must say "yes" to continue]

- Normally, what is the primary language spoken at this home?

  ____

- How many Latino (Hispanic) children aged 1 - 5 (12 - 71 months) live here of whom you are the parent or guardian?

  ______

- To the best of your knowledge, has this child (or these children) been tested for lead, where, and when?

  ____

- What is the reason that you do not want this child (or these children) to be in this study about lead exposure?

  ____

- How many Latino (Hispanic) children live here of whom you are not the parent or guardian?

  ______

- Can we contact the parent or guardian of that child (those children) to see if they want to participate in the study?

  [Circle response:] Y N

  [If respondent says "yes", leave *Study Recruitment Sheet* for other parent/guardian. Thank the person for his/her time, enter the result as #6 on the *Household Tracking Log*. Proceed to the next household.]

FORM C. Daily Household Tracking Log Instructions (modified CDC form)

Choose one of the following outcomes codes and note it in the Log on the reverse side.

- Unable to determine any information about household, neither by visual inspection nor via conversation with a knowledgeable individual (typically this applies to an address that appears to be invalid). Describe the reason under Additional Notes.

G. Gated community. Access is completely blocked, such as via a locked entry gate or door. Describe the situation under Additional Notes.

- Household appears unoccupied/vacant based on visual inspection.
- Household appears occupied, but occupants did not open the door and no further information was obtained.
- Household occupied, but occupant declined participation before eligibility could be determined.
- Household occupied, with eligible participants, but occupant declined participation.
- Household occupied, with eligible participants, but occupant declined participation. Occupant gave permission to contact another family within the household; however, other occupants were not at home.
- Household occupied, without eligible participants.
- Household occupied with eligible participants but parent or guardian was not available or was unable to provide consent.
- Household occupied with eligible participants who were enrolled in the study. **(SUCCESS!)**

Leave a copy of the Study Recruitment Sheet for Codes G, 3, 6, and 8.

Place it the door or under the mat. If leaving sheet at a gated community, clearly print apartment address on it.

Follow-up visits must be done for these codes. When possible, request an appointment time & mark under "Additional Notes".

Mark household completed after obtaining a code of either 2, 4, 5, 7, or 9.

FORM D. Household Tracking Sheet

Daily Household Log

Household Address: ______________________

Check when completed: ☐ Subsequent Address: ____________________________

Record **EVERY** Household Contact!

For "FOUND" Addresses:

Enter household address by hand.

Contact	Date of Visit **(MM/DD)**	Time of Visit ***(AM/PM)***	***Result Code*** (1 – 9 or G)	**Left Info***	**Additional Notes**
1st				☐	
2nd				☐	
3rd				☐	

* Leave a copy of the Study Recruitment Sheet for Codes G, 3, 6, and 8

Daily Household Log (Reverse Side)

Contact	Date of Visit **(MM/DD)**	Time of Visit *(AM/PM)*	***Result Code*** (1 – 9 or G)	**Left Info***	**Additional Notes**
4th				☐	
5th				☐	
6th				☐	
7th				☐	

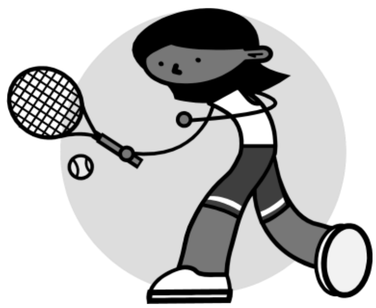
* Leave a copy of the Study Recruitment Sheet for Codes G, 3, 6, and 8

Reminder call requested (name/phone): ____

FORM E. Study Information Sheet

Information Sheet

San Diego State University is doing a research study on a harmful chemical called lead. The State of California is also participating in this study. We want to measure Latino children's contact with lead. We will test to find out where the lead is coming from. This will help us learn how bad the problem is and what needs to be done to protect children from lead poisoning.



To do this, **we are visiting a certain number of households in your area.** We test different parts of the house, inside and outside, for lead. Then we ask the parent or guardian some questions about the child. This helps us find out about the child's contact with lead. **Your household has been selected for this study.** This study is free and will take about an hour and 20 minutes. In return for your time, we will offer you an incentive gift worth roughly $20.

We would like to ask your help to let us know if children aged 1, 2, 3, 4, or 5 live here. If they do, we will schedule a time to visit you again. If children do not live here, we would like to know so we can take your name off our list. **Please call (619) 819-6425.** Your participation is voluntary at all times throughout the study. We hope you will take advantage of this opportunity to have your house tested. Thank you very much for participating.

Principal Investigator:
Kathryn C. Dowling, Ph.D., M.P.H.
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency
1515 Clay Street, Sixteenth Floor 510-622-2573
Oakland, California 94612 510-622-3211 (FAX)

FORM F. Consent Form

San Diego State University

Parental Permission/Informed Consent to Participate in Research

STUDY OF EXPOSURE TO LEAD AMONG SAN DIEGO LATINO CHILDREN

You are being asked to participate in a research study. Before you give your permission to participate, it is important that you read the following information. Ask as many questions as necessary to be sure you understand what you will be asked to do.

Investigators:
The Director of this study is Kathryn C. Dowling, Ph.D. She is a Professor at San Diego State University. She is also a Staff Toxicologist for the State of California, at the Office of Environmental Health Hazard Assessment. Other researchers from San Diego State University are participating in this study. Comprehensive Health Center in San Diego and the Environmental Health Coalition in National City are community partners on this study, with funding from the City of San Diego.

Purpose of the Study:
Lead is a chemical found in many products. It can harm children's learning, growth, and hearing. We want to find out how many children in this part of downtown San Diego have high levels of lead in their blood and where the lead comes from. This will help us learn how bad the problems are and what needs to be done to protect children from lead poisoning.

Description of the Study:
We will visit about 150 households in your area to test for lead. Your household has been selected for this study. If you agree to participate, we will ask about each of your children age 1 through 5 years. The study worker will ask you some questions about their behavior, the house and its residents, and factors that could cause lead exposure. At the same time, we will ask your permission to take samples of paint, soil, and water inside and outside of your house. This will take roughly 30-40 minutes. We will give you educational materials on how to prevent lead poisoning, which will take 10 minutes. All of this will take place in your home.

Also, we will offer you a free test for levels of lead in the blood of your eligible children who are participating in this study. A medical assistant from Comprehensive Health Center will come to your house. S/he is certified to draw blood and will prick the child's finger and take about 5 to 10 drops of blood. S/he will use new instruments that are clean and completely safe. The blood test will take less than 15 minutes. The blood will be taken to the San Diego County Public Health Laboratory and will be analyzed later. After the tests, the laboratory will destroy the blood samples. We will evaluate the results of the samples that we take inside and outside of your house and of your child(ren)'s blood. Based on the results, you may be eligible for free services to remove the lead hazard from your home.

If you give your permission, we will provide information on your eligibility to Environmental Health Coalition, which is providing those free services.

You may choose to use your own private doctor to get your child(ren)'s blood test, which you or your medical insurance would pay for. If you choose to have your child(ren)'s blood tested, we would like to include the result of the blood test in this study. In order for us to obtain a copy of your child(ren)'s results, we will ask you to sign a second form. That will give permission to your child's doctor to share the test result with the researchers on this study and the Environmental Health Coalition.

Risks or Discomforts:

The study includes a blood sample. Your child will feel a slight prick to the finger. Before the finger stick, the area of the finger prick will be cleaned with an alcohol swab. After taking the blood, the area will be covered with a small bandage to prevent infection. You will be instructed to maintain slight pressure on the area to minimize additional bleeding. Your child may have a slight bruise, soreness or swelling after the test is over. It is possible that your child may feel restless or uncomfortable and may resist the finger prick. If this is the case, you may ask the nurse to try again at a later time. Or you may decide that it is not possible to participate.

Another inconvenience of the study is the time you will spend answering our questions and allowing us to take samples inside and outside your house. Some of this information will be private in nature. You can refuse to participate in any part of the study that you choose.

Benefits of the Study:

We cannot guarantee that you or your child(ren) will receive any benefits from this study. However, we will provide educational materials to you about how to reduce your child(ren)'s exposure to lead. We will also explain how to obtain additional services from the County of San Diego. We believe the information that we collect will benefit other children in the State of California. The State will use this information to understand the problems of lead exposure for Latino children in California. This will help develop health programs to reduce these problems.

Alternative Methods of Treatment:

If you choose not to participate in this study, you will not lose any of the health care services that you normally receive. You can still get your child's blood tested for lead, through your child's physician. Or you may be eligible for low- or no-cost services through the County of San Diego. You also can directly contact either the Comprehensive Health Clinic at 619-231-9300 or the Environmental Health Coalition at 619-474-0220. They can help your child(ren) obtain the free test for levels of lead in their blood. If the test results show that your child(ren) need(s) medical care, s/he may be eligible for publicly funded health care. If the levels of lead in your house reach dangerous levels, the Environmental Health Coalition can help. For eligible households, they provide free services to help reduce the level of lead in your house and your child(ren)'s environment.

Confidentiality:

No names will be used on the questionnaires or observation forms. This information will be kept confidential. We will not link your name with your responses to these questions or with the observations we will make here today. When we report the results of this study, no information on your name or your child's name will appear.

The results of your child's blood test will be kept confidential to the extent possible by California law (Health and Safety Code Section 100330). By California law (Health and Safety Code Sections 105300 and 124130) this information will be reported to the State of California, your child's physician and the County of San Diego. This information will be used to provide follow-up health services to your child if s/he has high lead levels.

Incentives to Participate:

You will receive either an aluminum pot or a family-sized first aid kit, worth roughly $20. You will receive it after we complete the questionnaire and collect the soil, dust, and water samples.

Costs and/or Compensation for Participation:

There are no costs to you associated with your participation in this study. You will not receive any payment for your participation.

Voluntary Nature of Participation:

Participation in this study is voluntary. Your decision of whether or not to participate will not affect your future relations with San Diego State University or the State of California. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time. You will not suffer any penalty or loss of benefits to which you are otherwise entitled.

Questions about the Study:

If you have any questions about the research now, please ask now. If you have questions later about the research, you may call the study hotline at 619-819-6425. After the study ends, you may reach the Study Director at 510-622-3200. You may call her collect during business hours.
If you have questions regarding your rights as a human subject and participant in this study, you may call the Institutional Review Board at San Diego State University for information. The telephone number of the Committee is 619-594-6622. You may also write to the Committee at: SDSU Institutional Review Board, 5500 Campanile Drive, San Diego, CA 92182-1643.

Agreement:

The San Diego State University Institutional Review Board has approved this consent form as signified by the Committee's stamp. The consent form must be reviewed annually and expires on the date indicated on the stamp.

Your signature below indicates that you have read the information in this document and have had a chance to ask any questions you have about the study. Your signature also indicates that you agree to participate in the study and have been told that you can change your mind and withdraw your consent to participate at any time. You have been given a copy of this agreement. You have been told that by signing this consent document you are not giving up any of your legal rights.

____
Name of Parent or Guardian (printed)

______________________________________ ____________________
Signature of Parent or Guardian Date

______________________________________ ____________________
Signature of Study Director or Designee Date

FORM G. Household Questionnaire

Date of Interview: ____ ____ ____ **DAY MONTH YEAR**	**Household Address:** __________________
Name of Interviewer:	
Name of Sampler:	

<u>REMINDER:</u> Be sure to obtain the participant's signature on the Consent Form before beginning this interview.

<u>PART A – Household-Specific</u>

"I would like to ask you some questions about this household."

01	How many people and how many families live in this house? [*More than one family equals different parents*}	____ persons ____ families
02	What is the ownership type of your home? [*Please read responses. Mark all that apply.*]	Owner occupied …………………1 Rental ……………………………2 Public housing …………………..3 Publicly subsidized (Section 8)...4 Other _________________ ..… 8
03	Has any work been done on the home in the past 6 months? (*Any activity that has disturbed the home environment, such as painting, sanding, window replacement, etc.)* [*Mark all that apply.*]	Yes, inside ……..........…......... 1 Yes, outside ….........…........... 2 No ....…......... 3 Doesn't know 9
04	Does anyone living in this household participate in the following work or hobbies? [*Mark all that apply.*]	In construction or renovation of houses/buildings…1 In metal foundries (metals processing)……….…... 2 In battery recycling ...………….………………….. 3 As an automobile mechanic.……………………..... 4 As a welder …………….……………………….. 5 In a firing range …………..……………………….. 6 In fishing ……………………………………………. 7 As an artist working with stained glass or jewelry....8 Neither ……..………………………………..………9 Doesn't know …………………………………......10

"Now we will ask some questions about all the children aged 1 to 5 (12 – 71 months) who live in this household. I am going to ask you their birth dates, but if you do not know their birthdates, we can use their ages. I will also ask their gender and their relationship to you."

[NOTE: Seek the most knowledgeable respondent for each child – preferably the mother. This may mean interviewing more than one mother per residence.]

First Name	Age* (yrs)	Birth-date (mm/dd/yy)	Sex (M/F)	Family #	Respondent's Relationship to Child	Child Code Number (apply sticker)

***Age:** If the respondent does not know the child(ren)'s birthdate(s), ask him/her for the age(s) of the child(ren) and enter in the corresponding column.

SPECIAL NOTES:

PART B – Family-Specific

Child Code Number

(apply sticker)

Child Code Number

(apply sticker)

Child Code Number

(apply sticker)

[NOTE: If multiple children have the SAME MOTHER AND FATHER, it may be sufficient to administer PART B of the survey only once for the entire family. Use your best judgment.]

"We would now like to ask a few questions about your family's origins and identity."

11	The language spoken at home is:	**Spanish** only…………...…………………………….….1 **English** only ……………………………...…………....2 Mainly (but not exclusively) **Spanish** …………………..3 • Mainly (but not exclusively) **English** ……………..…4 • Both English and Spanish ……………..……...….5 Other language(s): ________________________ ..…... 7
12	Are either of [CHILD NAME]'s parents Mexican immigrants?	Father……...…………1 Mother …………………2 Both ….………………...3 Neither ..……………...8 Doesn't know...…………9
13	You, the mother of [NAME OF CHILD], identifies yourself as:	Mexican ..………………………1 Mexican-American ………….. 2 Chicano ………………………. 3 American ……………………….4 Other (specify):…………………7
14	How many years of schooling have you, the mother of [NAME OF CHILD], completed?	1 to 5 years...…. 1 6 to 9 years ……….……….....…………… 2 High School (10-12 years)......................... 3 Some College (incl. Associate's Degree)…. 4 Bachelor's (4-year) Degree………………….5 Some Postgraduate Studies.……………… 6 None……..…… 7 Does Not Know...........…......................... 9
15	Where (in what country) did you go to school?	Mexico ……………………………………….1 United States ………………………………….2 Mexico, then the U.S.. ……………..……...3 U.S., then Mexico ……………………..……...4 Other (specify): _________________........... 5
16	How much time did you, the mother of [NAME OF CHILD], spend in Mexico during the last	_____ days _____ weeks

	year? This could be as little as just a day trip.	_____ months	
17	Does the father* of [NAME OF CHILD] currently live here in this house? *[*Adjust if respondent is not the mother.]*	Yes .... **<u>1</u>** No 2	**<u>Go to 23</u>**
18	¿Do you currently live here with another man* who is your husband, partner or companion? *[*Adjust if respondent is not the mother.]*	Yes .... 1 No .... **<u>2</u>**	**<u>Go to 24</u>**
19	Is your spouse/partner/ companion a Mexican immigrant?	Yes .... 1 No .... 2 Doesn't know...………………… 9	
20	How many years of schooling has he* completed? *[*Adjust if respondent is not the mother.]*	1 to 5 years...…. 1 6 to 9 years ……...……….....…………… 2 High School (10 to 12 years)....................... 3 Some College (incl. Associate's Degree)….. 4 Bachelor's (4-year) Degree …….………..... 5 Some Postgraduate Studies.………………… 6 None.…...….... 7 Does Not Know............…........................... 9	
21	Where (in what country) did he go to school?	Mexico ………………………………………..1 United States ………………………………...2 Mexico, then the U.S.. …………………..…….3 U.S., then Mexico ……………………...……..4 Other (specify): ________________...........5	
22	How much time did he* spend in Mexico during the last year? This could be as little as just a day trip. *[*Adjust if respondent is not the mother.]*	_____ days _____ weeks _____ months	**<u>Go to 24</u>**
23	How much time did [NAME OF CHILD]'s father spend in Mexico during the last year? This could be as little as just a day trip.	_____ days _____ weeks _____ months	
24	[NAME OF CHILD]'s father identifies himself as:	Mexican ..…………………….…..1 Mexican-American..…………..2 Chicano …………………….....;3 American ………..……………....4 Other (specify): ____________ 7	

25	How many years of schooling has [NAME OF CHILD]'s father <u>completed</u>?	1 to 5 years..… 1 6 to 9 years ………..…………......…………… 2 High School.............….............................3 Some College (incl. Associate's Degree)…. 4 Bachelor's (4-year) Degree …….………… 5 Some Postgraduate Studies.………………..6 None……...… 7 Does Not Know.............…........................ 9
26	Where (in what country) did he go to school?	Mexico ………………………………………1 United States ………………………………..2 Mexico, then the U.S.. …………………..……...3 U.S., then Mexico ……………………..……...4 Other (specify): ________________ 5
27	Where does the water you use for cooking come from?	Tap……….. 1 Bottled water delivered to the house ….... 2 Bottled water purchased at a store …........3 Some tap water and some bottled water …4 Other (specify: ________):………………...8 Does not know..9
28	What types of pots and pans do you use?	Clay ………………………………..1 Aluminum ……………………….. 2 Teflon ……………………..……..... 3 Other (specify): ____________.…. 8
29	What types of foods do you usually **<u>cook</u>** in clay pots and pans such as these? *[Show picture]* *[Open-ended question – write down the 3 top answers]*	________________ ________________ ________________ None …………….9
30	What types of food/beverages do you usually **<u>serve</u>** in clay dishes? *[Show picture]* *[Open-ended question – write down the 3 top answers]*	________________ ________________ ________________ None ……………..9

<u>**PART C – Child-Specific**</u>

[NOTE: Be sure to mention the child's name before beginning. Fill out Part C of the questionnaire for EACH eligible child.]

Child Code Number
(apply sticker)

"As part of our study, we take samples for later analysis in our lab. With your permission, my partner is going to take a sample of your kitchen tap water. We would also like your permission to take a paint sample from the entryway of your house. We will ask to see the area where [NAME OF CHILD] sleeps. There we will take paint samples from the area. Finally, we would like to ask you for a small soil sample. We would prefer to take soil from the area where [NAME OF CHILD] likes to play outside the house (e.g. yard, patio). Would you be kind enough to show us these places? "

[Proceed if permission is granted]

"Now, we would like to continue by asking you some questions about [NAME OF CHILD]'s activities."

31	Where does the water [NAME OF CHILD] drink come from? *(Mark all that apply)*	Tap………... 1 Bottled water delivered to the house ………. 2 Bottled water purchased at a store …........... 3 Some tap water and some bottled water …...4 Other (specify: ________):………………….. 8 Does not know... 9
32	Does [the child] suck his/her thumb and/or other fingers?	Yes .... 1 No .... 2 Does Not Know…......... 9
33	Have you seen [the child] eat dirt in the last year?	Yes .... 1 No .... 2 Does Not Know….......... 9
34	Have you seen [the child] eat paint chips or peel off paint in the last year?	Yes .... 1 No .... 2 Does Not Know…......... 9
35	During a normal <u>day</u>, how many hours does [NAME OF CHILD] spend <u>outdoors, at home,</u> such as in the yard or patio?	Normal **Week day** (Mon/Tues/Wed/Thurs/Fri): ____ hours Normal **Week-End day** (Sat, Sun): ____ hours Does not play outside/ Zero hours …............. 7 Does not Know ………………………………… 9

36	Does [NAME OF CHILD] regularly spend more than 10 hours each week in a place away from home?	Yes .... 1 No .... **2** Does not Know 9		**Go to 41**
37	In how many different places?	__ __ PLACES		

		A. Place 1	B. Place 2	C. Place 3
38	How many hours per week does [NAME OF CHILD] spend in the [first/second/third] place?	__ __ HRS/WK	__ __ HRS/WK	__ __ HRS/WK
39	Does someone other than you take care of [NAME OF CHILD] when he/she is at this place?	Yes .... 1 No .... 2 Doesn't Know .. .9	Yes .... 1 No .... 2 Doesn't Know .. .9	Yes .... 1 No .... 2 Doesn't Know ... 9
40	What type of place is this?	School:……………….…1 Kindergarten/ Pre-School:…………....2 Daycare: ….................3 A babysitter's home ...4 A relative's home: …..5 Other:.____________ 7	School:……………….…1 Kindergarten/ Pre-School:…………....2 Daycare: ….................3 A babysitter's home ...4 A relative's home: …..5 Other:.____________ 7	School:……………….…1 Kindergarten/ Pre-School:…………....2 Daycare: ….................3 A babysitter's home ....4 A relative's home: …... 5 Other:.____________ 7

41	Where was [NAME OF CHILD] born?	Mexico – in a northern border state (Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, Tamaulipas)…………………………….…1 México – Other state (specify): _________________...………..2 California …………………………………………………………...3 U.S. – Other border state (AZ, NM, TX)……………………………4 U.S. – Other state (specify): ____________________..............5 Other Latin American country (specify): ________________......6 Spain ……………………………………………………………7
42	The child is a:	Mexican Citizen ___ U.S. citizen ___ Has double nationality (Mex/US) ____ Other citizenship (specify): ____________

43	How long has [NAME OF CHILD] lived in this house?	____ years _____ months … 1 His/Her whole life………...…………**2** Does Not Know......... …......…..... 9	**Go to 46**
44	How long has he/she lived in the study area - zip codes 92102 or 92113)?	____ years _____ months …1 His/Her whole life………...…………**2** Does Not Know......... …................9	**Go to 46**

45 – What are all the places [INSERT NAME OF CHILD] has lived during the course of his/her life? When did he/she move there?

DATE and PLACE MOVED TO (from birth to date)	Does not know date	**Mexico** – border state	**Mexico** – **non**-border state	**U.S.** – border state	**U.S.** – **non**-border state	Other Country (specify)
Ex: *Yr: 2002 Mo: May*			*Michoacan*			
Yr: ___ Mo: _____						
Yr: ___ Mo: _____						
Yr: ___ Mo: _____	☐					
Yr: ___ Mo: _____						

46	During the past year, has [NAME OF CHILD] been taken to Mexico? This could be for just a day trip.	Yes... .... 1 No .... **2** Does Not Know......... .... **9**	 **Go to 48** **Go to 48**
47	How long was he/she in Mexico? Where? [*Write down the two main places visited by child*]	_______________ (City and/or State) ____ days ____ weeks ____ months _______________ (City and/or State) ____ days ____ weeks ____ months	
48	What candies/treats does [NAME OF CHILD] like to eat? *[Open-ended question – write down the 3 main answers]*	______________________ ______________________ ______________________	

49 - [Show pictures of candies]

Which of these candies does [NAME OF CHILD] usually eat? How often does s/he eat each candy? How much does s/he usually eat at one time? NONE (Circle) **Go to 51**

Picture No.	**Frequency** (per day, week, month, or year)	**Usual portion and unit of measure**
Ex: *C* .	*3* time(s) per *week* .	*2* *(#)* *bars* (unit of measure)
_____	____ time(s) per ________. ___	____ (#) _________ (unit of measure)
_____	____ time(s) per ________. ___	____ (#) ________ (unit of measure)
_____	____ time(s) per ________. ___	____ (#) _________ (unit of measure)
_____	____ time(s) per ________. ___	____ (#) ________ (unit of measure)
_____	____ time(s) per ________. ___	____ (#) ________ (unit of measure)
_____	____ time(s) per ________. ___	____ (#) ________ (unit of measure)

[Common units of measure: bar, mini-jar (*jarrito*), lollipop, piece]

50	Where does he/she get them from? *[Mark all that apply]*	Candy Shop……………………………………………1 Market……………………………………………………2 Parties/piñatas ……………………………………………3 Neighbors who sell them…………………………………..4 School ……………………………………………………5 Non live-in relative ………………………………………6 At home ……………………………………………………7 Trips to Tijuana……………………………………………8 Other (specify): ___________………………...9	
51	How often does [CHILD] have food/beverages **cooked** in this type of clay pots? This may include food/beverages served to him/her by someone else, such as a relative or other caretaker. *[Show photo of pottery again]*	___ times per ______	
52	How often are these same foods/beverages **served** to [NAME OF CHILD] in this kind of clay dishes? This may include food/beverages served to him/her by someone else, such as a relative or other caretaker. *[Show photo of pottery again]*	___ times per_______	
53	How many times has [name of child] suffered from colic (tummy ache)?	# of times: _____ …..…..1 Never ……………………...**7**	**Go to 55**
54	How was [NAME OF CHILD]'s colic (tummy ache) relieved? *[Open-ended question – write down the 3 top answers]*	________________ ________________ ________________	

55 – Do you know the names of any of these remedies? How many times have these kinds of remedies been used to relieve [NAME OF CHILD]'s colic, or any other illness? What amount of the remedy was usually given?
[Show pictures of home remedies]

DOES NOT KNOW NAMES (Circle) NEVER USED (Circle)

Name of remedy	**Number of times**	**Usual amount and unit of measure**
Ex: *Maria Luisa*	*3*	*3* (#) *dedos* (unit of measure)
		____ (#) ________ (unit of measure)
		____ (#) ________ (unit of measure)
		____ (#) ________ (unit of measure)

[Common units of measure: pinch, teaspoon (tspn), tablespoon (tbspn)]

56	Where do you get the remedy(ies) shown in the pictures? *[If the respondent could not name any of the remedies in Question 55, modify question as below.]* "Do you know where to get the remedies shown in the pictures?	Healer in Mexico ....1 Herbal Remedy Store in Mexico............. 2 Healer in California ....3 Herbal Remedy Store in California .... 4 Relative .... 5 Neighbor .... 6 Other _______________……………... 8 Does Not Know ………………..……..… 9

"We will end with some information about your child's medical care."

57	What type of medical insurance does [the child] have right now?	Private, through work ……................... 1 Private, out-of-pocket .... 2 MediCal .... 3 Healthy Families .... 4 California Kids …………………….…. 5 Kaiser Cares for Kids……………........ 6 None ....**<u>7</u>** Other ___________________________ .8	 **<u>Go to 59</u>**
58	During the past year, has [NAME OF CHILD] ever been <u>without medical insurance</u>?	Yes............................. 1 No ....….............. **<u>2</u>** Does Not Know........... 9	 **<u>Go to 60</u>**
59	Through which healthcare program does [name of child] receive medical care while he/she <u>does not have medical insurance</u>?	Community Clinic or Health Center……..... 1 Emergency Room...……………...............… 2 Fee-for-Services Clinic...............................… 3 Services in Mexico…....... ……................... 4 None…...............……………………….... 7 Other ______________________________.....8	
60	In the past year, was there ever a time when [name of child] needed to go to the doctor, but was unable to due to cost?	Yes.. .... 1 No ....…..... 2 Does Not Know............ 9	
61	Has [name of child] received a blood lead test?	Yes.............……........ 1 No .... 2 Does Not Know............ 9	 **<u>End</u>** **<u>End</u>**
62	When and where did [name of child] get the blood lead test?	Date: _________ (month/day/year) Place: ____________________	

<u>"Thank you for participating in this study. We would now like to thank you with an incentive."</u>

<u>[NOTES: 1) If the respondent indicated she uses pottery, offer to test with a Lead-Check swab and suggest a pottery exchange. 2) Offer the respondent the chance to have her children participate in follow-up services: the free blood lead testing and (for those qualifying) lead hazard control. If s/he agrees, fill out the necessary paperwork.]</u>

FORM H. Environmental Assessment Form (modified CDC form)

[Complete form for all households 1) that enrolled in the study (front and back of form) or 2) that refused participation or with which no contact could be made (front only).]

Child Code Number
(apply sticker)

Child Code Number
(apply sticker)

Child Code Number
(apply sticker)

Child Code Number
(apply sticker)

Latitude of the house: ____________°

Longitude of the house: ______________°

No.	Environmental Assessment	Coding categories
A	What type of housing is this? (*Choose one*)	Single dwelling .... 1 Attached dwelling (duplex, etc) .... 2 Apartment ..…... 3 Trailer …………………………..……..… 4 Other: __________________ ………….. . 10
B	Describe the exterior of the dwelling. (*Mark all that apply*)	Brick……………………...……………1 Wood……………………………………..2 Siding…………………………………….3 Stucco……………………………………4 Other: __________________ …………..10
C	Describe the condition of the paint on the exterior of the dwelling. (*Mark all that apply*)	Intact……………………………………….1 Moderate Peeling……………..…………2 Severe Peeling…………………….…….3 Moderate Chipping…..…………………….4 Severe Chipping…..……………………….5 Moderate Chalking……..…………………..6 Severe Chalking……..……………………...7 Moderate Cracking…………..……………...8 Severe Cracking……………..………………9 Other: __________________ ……………...10
D	Is there any evidence of debris/paint chips in the soil near the drip line of the building?	Yes .... .1 No .... 2 Don't know/no access.…………………...3 No soil drip line (note reason below)..…..4

Print additional notes or comments (note letter to which the comment corresponds):

E	Describe the condition of the paint in the child's sleeping area. (Mark all that apply)	Intact………………………………………1 Moderate Peeling………………..…………...2 Severe Peeling……………………..………3 Moderate Chipping…..………………………4 Severe Chipping…..…………………………5 Moderate Chalking……..……………………6 Severe Chalking……..……………………..7 Moderate Cracking…………..………………8 Severe Cracking……………..………………..9 Other (Please describe below)………..……..10 No access to interior………………….........11
F	Describe the degree of dustiness in the child's sleeping area.	Floor carpeted with no dirt visible………………. 1 Floor carpeted with moderate dirt visible …......…2 Floor carpeted with severe dirt visible ……....…. 3 Floor not carpeted with no dust visible…...…..…. 4 Floor not carpeted with moderate dust visible…... 5 Floor not carpeted with severe dust visible ………6
		Neither windowsills nor miniblinds dusty..………..7 Either windowsills or miniblinds moderately dusty..8 Either windowsills or miniblinds severely dusty….. 9 No access to interior……..……………………….. 11
G	Describe the degree of foliage or pavement covering the child's play area. (Mark all that apply)	Bare soil………………………………...……1 Roughly one quarter covered…..……..………2 Roughly one half covered …..………………..3 Roughly three quarters covered ……………..4 Fully covered ....……………………………..5 Child does not play outside ………………….6 No information on child's play area…....…..11

Print additional notes or comments (note letter to which the comment corresponds):

Form J. Sampling and Chain-of-Custody Information

Name of Sampler: ________________________ Sampling Date: **Child Code Number** **Child Code Number**

Name of Analyst: ________________________ ______________ (apply sticker) (apply sticker)

Sample Code	Room	Location	Matrix	Surface type	Dimensions	Area (ft^2)	Date Digested	Date Analyzed	Lab Results
_ _ _ _ WTR			Water	N/A	N/A				
_ _ _ _ DUE			Dust		12 in. x 12 in.				
_ _ _ _ DUW			Dust		___ in. x ___ in.				
_ _ _ _ DUF			Dust		12 in. x 12 in.				
_ _ _ _ PAI			Paint		trace in box				
_ _ _ _ SOI	N/A		Soil	N/A	N/A				

**Room= Living, dining, kitchen, bedroom, etc.
**Location= near front door, next to bed, near flower bed, etc.
**Matrix= Soil, dust, paint, water
**Surface type= wood, tile, carpet, cement, etc.

Lab analyst completes the shaded areas.

Total number of samples on this page:________

Instructions: Enter "N/S" for samples not taken, in the location column.

Trace a rough outline of the paint area sampled (after transferring paint into sampling container). Use the box to the right as a guide (2 in. x 4 in.)

ANNEX:

QUESTIONNAIRE PHOTOS

A

B

C

D

E

F

G

H

L


BOTICA "GUADALUP